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The Museum and the Individual

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That museums are educational institutions has been a well-accepted fact for some time, and museums have responded to the idea admirably. This is not enough. Museums cannot afford to accept the attitudes and methods of our current educative procedures. Our basic ideas about education and desired ends should be examined and possibly revised.

Our general educational philosophy has become built around our adoration of mass-production techniques. It is, moreover, largely concerned with the presentation of facts to be learned and is badly confused with training. Mass production, to be successful or even possible, requires uniform material and produces a uniform product. As citizens, we do not have the one and do not want the other. As to facts, they may be or seem useful to an individual, or not. In the case of those at undergraduate level, very little of the imparted information has any meaning beyond a vague faith that it is necessary to economic success. This unfortunate educative flaw was noted by Leonardo da Vinci who wrote, "just as food taken without appetite is injurious to the health, so knowledge without desire is harmful to the mind and it retains nothing." St. Augustine, a millennium earlier, had noted the same circumstance in looking back at his own education. As to training, we train animals; to speak of teacher training, as do our colleges and universities, is to insult a profession. We should educate people. We have progressed very far from the real meaning of the word "educate," which is "to lead forth."

People are individuals. Museums have a real opportunity to pioneer in new approaches and methods to educate individuals, the real purpose of which is to make them aware of themselves and their environment, natural and human. Museums have the advantage of not being involved

in a vast organization that is a mixture of state and local administrations and professional and lay authorities. They can act as autonomous entities and adapt to and take advantage of the individual circumstances of their areas, facilities, and interests. They do not have captive audiences, which enables them to concern themselves with individual responses which are the only responses that exist. The success of a democratic society depends directly on the quality of its individual members. This is important.

Much has been learned in the past fifty years about the nature of the individual, and there is much to be learned. Museums should take advantage of the knowledge that is available and design their activities accordingly. There are also opportunities for research and new knowledge in the field of what is both broadly and loosely called visual education. Museums are the obvious places for such research.

This will require some new thinking on the part of curators. Interest must be centered not on things but on the meanings of things to ordinary people with ordinary lives and backgrounds. This would be simple if meanings were fixed and universal—which they are not, but there are common ones. Curators, like all professionals, are specialized people. They usually become curators one way or another because of a love of the things they are to care for. Love is not always rational. The lover also is inclined to believe that everyone should feel as he does about the object of his affections. The separation of specialist and public is very largely due to the intolerance of the specialist, which is in turn due to lack of consideration of the interests and desires of laymen who have specialized interests and desires of their own. I remember the profound shock to a convention of radio executives and producers caused by the convincing announcement that there is no such thing as a radio audience—just so many individual listeners. That radio and television have taken that knowledge to heart should be obvious. Museums must accept the fact that there is not a museum audience, but just a number of individuals, each one of whom must be considered as a separate entity.

These individuals have things in common; we can know what they are and play to whatever common denominator we choose. We can choose the lowest, as must the commercial people, and be equally "successful," or the highest, and believe in and hope for the best. At least we would be doing something instead of merely existing on the premise that knowledge is supposed to be good.

Determination of the nature of the individual is no task to be taken lightly.

As a starting point, the most elementary fact about an individual is that he or she is a living organism and shares with all living organisms two essential characteristics: absolute isolation from the outer world or environment and absolute dependence upon it for existence. That it is

capable of reproducing itself may or may not be of interest to a particular museum. But it is important to realize that the existence of any life form, and in the case of man a personally satisfactory existence, depends upon the relationship it is able to establish with its environment. *Homo sapiens*, like any other living organism, knows of the existence of environment only by virtue of his ability to interpret what his senses or perceptory apparatus tells him about it. Here one encounters a skill, and skills must be acquired. We are not born with them. It is this skill at transmuting the messages our vision provides into general knowledge that museums can enhance and thereby become a valid and vital educational institution.

It is by the ability to handle generals into which particulars fit rather than a great variety of particulars that cultures are measured and that distinguishes creative man from robots or ants or bees. It must have been particulars that were released from Pandora's box. There is no great difference between a museum's displaying a stuffed two-headed calf and a fancy exhibit on the life cycle of a butterfly unless the life cycle is shown to be a part of the economy and working of life in general. A museum can by a wealth of material and attractive display of it attract visitors, but the museum's concern should be less for the number of its visitors than for what it does for them. If it wants to be an educational institution, then it must have an educative philosophy. It must offer the individual visitor something more than the fleeting pleasure of novelty. It must offer visual material that induces thought, which demands to be seen more than once. It must gratify desires that refer to daily life and experience with things and people, and, for that, decisions on what those desires may be are required of it.

Adjustment of the individual to environment is a fundamental necessity and most elementary desire, but most of us do not tackle the problem with any appreciable degree of consciousness. That consciousness could be made more acute. We learn the things we think we have to know and then stop. Curiosity should increase with knowledge, but our school system knocks it out of us in childhood. It can and must be restored. Museums could do it.

There are two kinds of environment man must deal with—natural and human. We are confronted as individuals with the working of the natural world and its works and the working and works of man. The more we understand them, the better we understand ourselves and the better we live our lives. Book knowledge cannot provide this kind of understanding. "There is no substitute for direct aesthetic perception" (quotation from Whitehead's "Science and the Modern World"). We can be informed that when we have dinner we are enjoying the results of highly technical control over many aspects of the behavior of nature in many parts of the world and the skills of hundreds of men, and we may or may not be

impressed. To feel a part of such a vast enterprise is something else.

There is a great difference between being told about something and experiencing it. Things we are told remain apart from us until experience validates them. Schools provide information; museums can provide experience. What experience and how to provide it are matters of choice, but human experience goes beyond the ability to identify objects and the learning of which ones are useful and how to use them, and which to avoid. To live harmoniously with new events requires understanding of behavior, not knowledge of a vast number of events that have already occurred—generals rather than particulars.

This does not mean that a museum should throw out all its particulars. All objects are particulars; there are no generals as objects. It is a matter of how objects are shown, or how they fit into a pattern, and patterns or orders are ideas, concepts, generals. The idea need not be fixed or even definite. Ideas can and should grow and change, but they must exist and must be created. Ideas do not spring out of the blue or the brow of Zeus, but evolve. Curatorial bull sessions on the theme of, "What are we trying to do?" could in the course of time produce ideas we have not dared to dream about as yet. The larger the idea, the more things are a part of it, and the higher and more inclusive the unity we can achieve. Unity is itself an idea, a concept. Religion has long held to the idea of an essential all-embracing unity; recently science is building towards the same concept. The unity of the natural world cannot be demonstrated abstractly as can that of the physical world. The quality we call life must be experienced and understood, and one individual cannot explain it to another. It is something that cannot be taught or even shown. What can be done is to create a situation in which the individual learns. This should be the role and function of museums.

The following quotations from Alfred North Whitehead's "Aims of Education" may be useful as ideas to ponder as they apply to the educative functions of a museum.

> There is only one subject matter for education, and that is life in all of its manifestations.
>
> What education has to impart is an intimate sense for the power of ideas, for the beauty of ideas and for the structure of ideas, with a particular body of knowledge which has particular reference to the life of the being possessing it.
>
> In my own work at universities, I have been much struck by the paralysis of thought induced in pupils by the aimless accumulation of precise knowledge, inert and unvitalized.
>
> The function of a university is to enable you to shed detail in favor of principles. When I speak of principles I am hardly even thinking of verbal formulations. A principle which has thoroughly soaked into you is rather a mental habit than a formal statement.

The ultimate motive power, alike in science, in morality and in religion, is the sense of value, the sense of importance. It takes the various forms of wonder, of curiosity, of reverence, or worship, of tumultuous desire for merging personality in something beyond itself.

All this may sound like an ultimate ideal to be achieved in some distant future and requiring radical alterations, but beginnings can and should be made from where we are. It could take very little to make a large difference.

The important thing is to have definite attitudes and desires against which we can measure everything that we do. If we want our visitors, who are individuals, to share our knowledge, we must give them something of its meaning to themselves as living parts of a living world. Their knowledge and use of it will always be different from ours; it is our attitudes that we can share. For this, we must be consciously aware of our own. Our curiosity, wonder, and delight are the driving forces that keep us constantly seeking knowledge. We should realize that the particular facts we acquire are only important because they fit into and enlarge a total concept. It is awareness of life, not just facts of life, that we must provide.

It is essentially a problem of communication. We must first be sure of what we want to say, then find a communicative device that will do what we want. The device will be found to be closer to art than to language. "Art imitates the *working* of Nature" (Thomas Aquinas)—not the *works* of nature.

Chalk Murals

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In 1953 the newly revised Brontosaur Hall was opened at The American Museum of Natural History. Among the various features of this large hall that elicited quite a lot of interest and a great deal of comment among museologists and museum visitors were the mural designs, done in white chalk on the deep blue walls above the exhibition cases. Here was something different and new in the concept and technique of museum murals, so we thought, and so we still think after five years of contemplative review. Various museum people have cast their professionally critical and inquiring eyes upon these decorations during these past five years, and they have asked questions. And the questions are still being asked, especially by those who now see the murals for the first time.

Developments in museum practices and techniques, like so many things that happen in life, frequently come about in unexpected and even accidental ways. Oftentimes, like Topsy, they "just grow." Certainly this was true to a large degree of the chalk murals in the Brontosaur Hall.

When it was decided that this hall should be done over, the several persons concerned with, or directly interested in, its planning were faced with the problem of what was to be done about the great expanses of wall above the built-in exhibition cases that rim the periphery of this large room. The words "great expanses of wall" are no idle figure of speech in this connection, for the Brontosaur Hall is 142 feet in length, fifty-eight feet in width, and the height from floor to ceiling is twenty-four feet. Because the wall cases are nine feet, four inches tall, the wall spaces above the cases are about fourteen and a half feet in height all around the hall—spaces broken only by a few large windows and by the ample entrances at each end of the hall. It was indeed a problem to

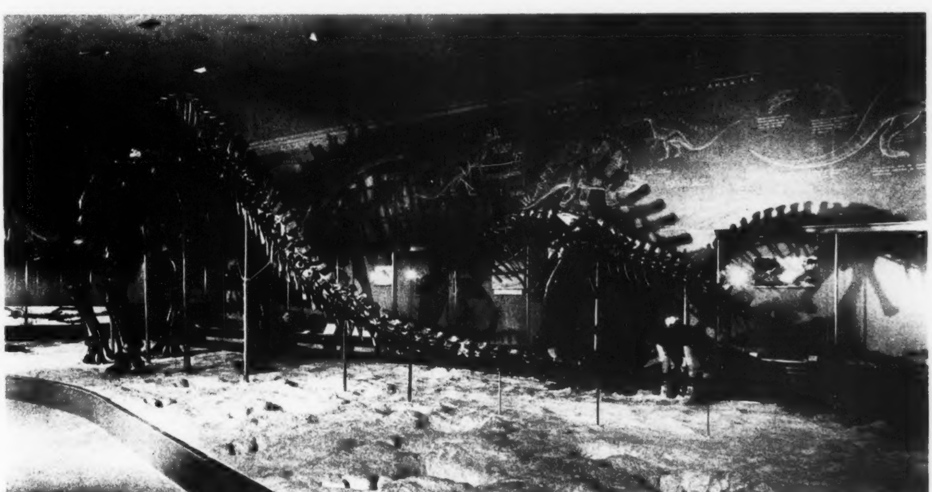
give us pause, for we were confronted with somewhat more than 300 linear feet of walls, divided by the windows and the entrance doors into seven large units. Of these, the largest is a space more than 100 feet in length on the south side of the hall, while on the north side are two spaces, each about 45 feet in length. At the east end the available spaces flanking the entrance to the hall are each about 30 feet in length; at the west end the corresponding spaces are each about 26 feet long. Here without doubt was a lot of space to be covered by murals, and likewise a lot of space to leave empty.

If there are to be 300 running feet of murals, all fourteen feet in height, they can be very overpowering, even in a hall as large as the Brontosaur Hall. The last thing we wanted to do was to pull the eye away from the exhibits. Yet this amount of blank wall space might be deadening, and in a sense overpowering because of its very dullness.

What were we to do?

One decision we agreed upon at the very beginning of this project was that the "scenic" type of murals, or perhaps what one might call the

Fig. 1. A view of Brontosaur Hall from the west end, showing on the south wall a portion of the long chalk mural that illustrates the Morrison fauna of Jurassic age. Exhibits to which this mural is applicable are now in some of the wall cases beneath the mural and on the large center island, a large part of which is shown in this figure.



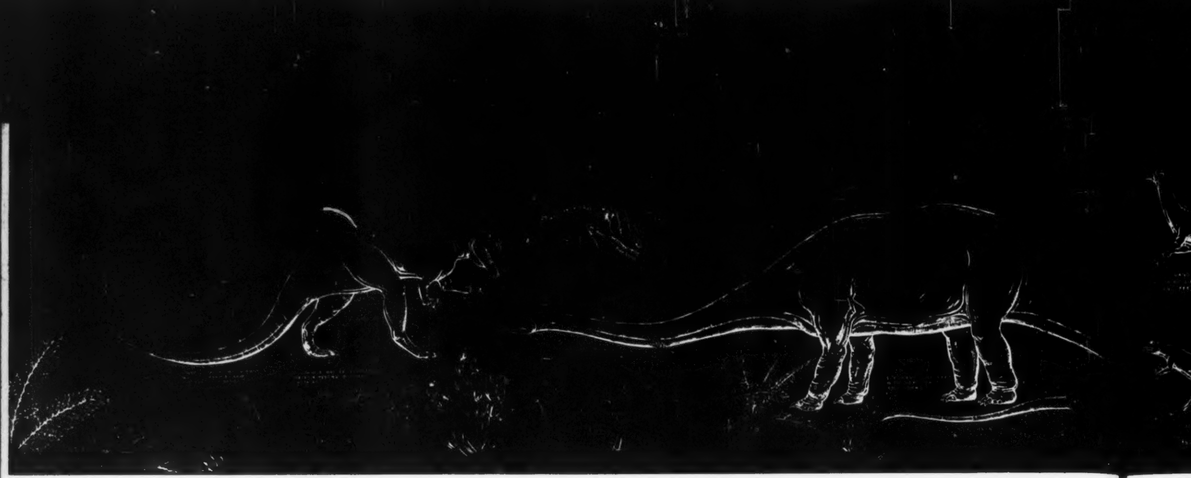


Fig. 2. A section of the chalk mural illustrating the Morrison fauna (see Fig. 1). Note the way in which the drawings stress basic features of dinosaurian anatomy, in addition to showing the general appearance of the land-living reptiles and the plants of late Jurassic age. The leaf-forms of these plants are especially decorative in this medium.

"conventional" murals done in oils, should not be used in Brontosaur Hall. The problem mentioned above of diverting visitor interest away from the fossils and to the walls could hardly be avoided if there should be processions and panoramas of colorful dinosaurs and turtles and other reptiles (many of them not very much less than life size), ferns and palm trees, and cliffs and volcanoes, going around the hall in a sort of Sistine Chapel treatment of the Age of Reptiles. This would never do; the walls must be subordinate to the exhibits. As against this precept we agreed that the wall decorations should supplement the displays beneath them. Thus the murals were to be more than decorative projections into the past; they were to be drawings or designs that would help to explain the exhibits. All this thinking was very fine in theory, but it needed to be implemented in a practical way.

The author of the present account had some vague ideas about large, cut-out silhouettes, done in a light and modern style, and perhaps set out a few inches from the wall. At this point Albert E. Parr, who was much interested in and gave much constructive help to the planning of the hall, suggested white-line decorations painted on the dark blue walls, to give somewhat the effect of blackboard sketches. Parr indeed envisaged the murals so strongly in terms of blackboard sketches that he advocated very informal designs surrounded by a considerable amount of rather roughly lettered explanations, as if some acrobatic professor had clambered around over the great walls, drawing on them pictures of the past as he saw it, and writing down, in the way that one does write on a blackboard, explanations to give significant meaning to the pictures —all for the edification of the observers on the floor below.

Not all of those involved in the planning of the hall agreed completely with this concept. Certainly the artists had ideas a little less informal

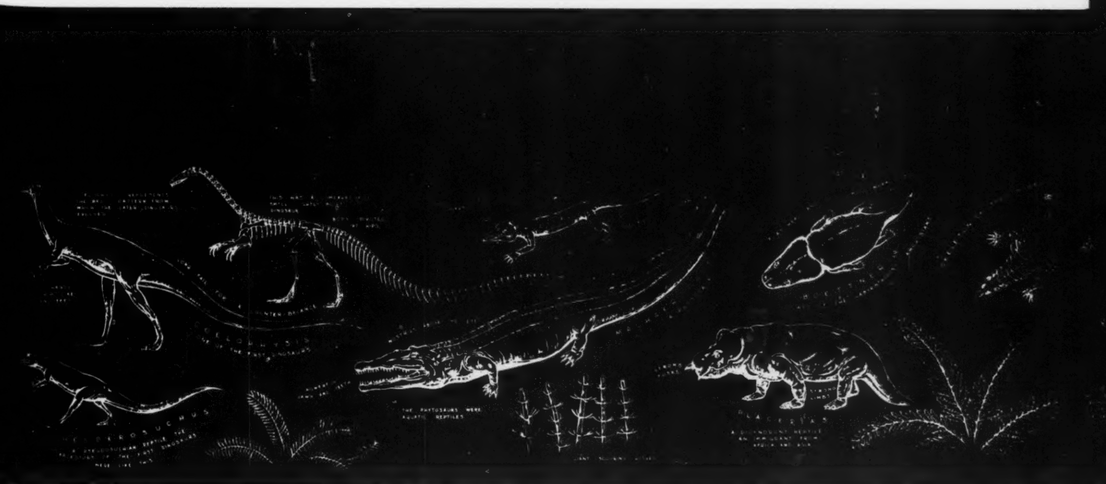


Fig. 3. The exhibit of the Chinle fauna of Triassic age, with the chalk mural that pertains to it on the wall above. In this mural, as in some of the others, both skeletons and restorations of the animals as they appeared in life were used. In this way the murals can be linked very closely with the exhibits beneath them.

than this, but the general idea was developed with enthusiasm, and the more it was passed back and forth, the more the enthusiasm grew. One thing led to another, and very shortly we were committed to the concept of white-line paintings on the walls, with much explanatory lettering to give the drawings some sound intellectual value.

It was decided to devote the two spaces at the west end of the hall to pictures of the early amphibians and reptiles of Permian and Triassic age. Above a display of Permian fossils from Texas was to be a decoration to show what these animals looked like in life. A similar representation was to be made of the famous Permian and Triassic Karroo faunas of South Africa, on the wall above the Karroo display.

A continuation of the Triassic story was to be carried over to the west end of the north wall, where, in the cases beneath, Triassic fossils from the southwestern states are exhibited. The other half of this wall was to be devoted to those Mesozoic reptiles (of Triassic, Jurassic, and Cretaceous ages) that became adapted to life in the oceans. The insertion of these marine reptiles into the picture sequence was not exactly consistent, in view of the fact that their fossil remains are on display in a corridor outside the Brontosaur Hall. We consoled ourselves with the ancient maxim that absolute consistency can at times be the indication of small thoughts and agreed that in this particular instance some inconsistency was justified.

On the long, uninterrupted south wall was to be a design showing the well-known upper Jurassic dinosaurs and other reptiles that are found in the Morrison sediments of western North America. Need it be said that there is a Morrison display in this part of the hall?

At the east end of the hall were to be two murals showing certain Cretaceous dinosaurs: on the one hand those forms from the Belly River

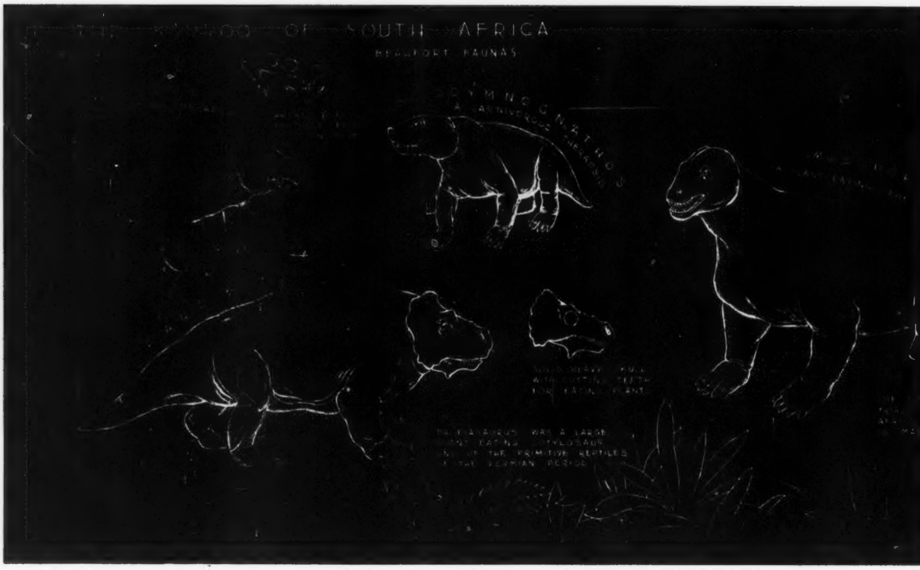


Fig. 4. The Karroo exhibit with the pertaining chalk mural above it. Here are illustrated by specimens and by restorations the mammal-like reptiles found in South Africa.

sediments of Alberta; on the other, those from the Lance and Hell Creek beds of the western states. The exhibits beneath these murals are synoptic teaching displays on the phylogeny and the ecology of the dinosaurs; Cretaceous dinosaurs as such are exhibited in another hall. Again an inconsistency, but again a justified one in our opinion. Plans did not call for any murals in the Tyrannosaur Hall, which houses the Cretaceous dinosaurs; consequently, we felt that we should round out the picture story of the dinosaurs in the Brontosaur Hall.

The basic sketches for the murals were done by Mr. Joseph M. Guerry, in cooperation with the present author and with the able advice of Miss Katharine Beneker, who was in charge of exhibition work in the hall. Many an hour of my alleged vacation was spent in checking and criticizing drawings, without complaint, for it was fascinating and a lot of fun.

After the sketches (cartoons in the original sense of the word) were completed to the general satisfaction of all concerned, they were photographed in sections, and standard lantern slides were made of the photographs. A projector was set up on a tall, movable platform, and from this

vantage point each slide was projected on the wall at the proper position and at the proper scale. Then it was merely a matter of tracing the projected picture, a task that was carried out by Mr. Guerry and by Mr. Robert Gartland.

The tracing was done with ordinary blackboard chalk, and the work progressed rapidly. In the course of a couple of months or so the more than 300 running feet of wall space had been completely filled with chalk drawings. Think of the contrast in time and effort with what would have been involved had we been doing the usual type of oil murals.

Here the work took an unexpected turn. We had intended to paint over the chalk lines with white oil paint, but everybody liked the quality of the chalk drawings so much that mutually we decided not to make oil-line paintings of them. The chalk lines had a lovely, soft effect that could never be duplicated in oils. It seemed a pity to do anything to these chalk sketches on the walls, and that is how, quite spontaneously, this technique of chalk-line murals came into being.

We had ideas of fixing the drawings, but every fixative that was tried turned the chalk lines from white to yellow. In the end we decided to leave the sketches as they were—as untouched chalk drawings. They have been up for five years now and seem as fresh as when they were first drawn. If nobody gets up on the cases and rubs against the walls (which they are not likely to do) the murals should remain indefinitely in their early freshness—indefinitely, that is, until the walls themselves are so dirty and dingy that refurbishing of the hall becomes necessary. Then the murals can be erased, the walls repainted, and the murals retraced, with modifications and corrections if such are necessary or desired.

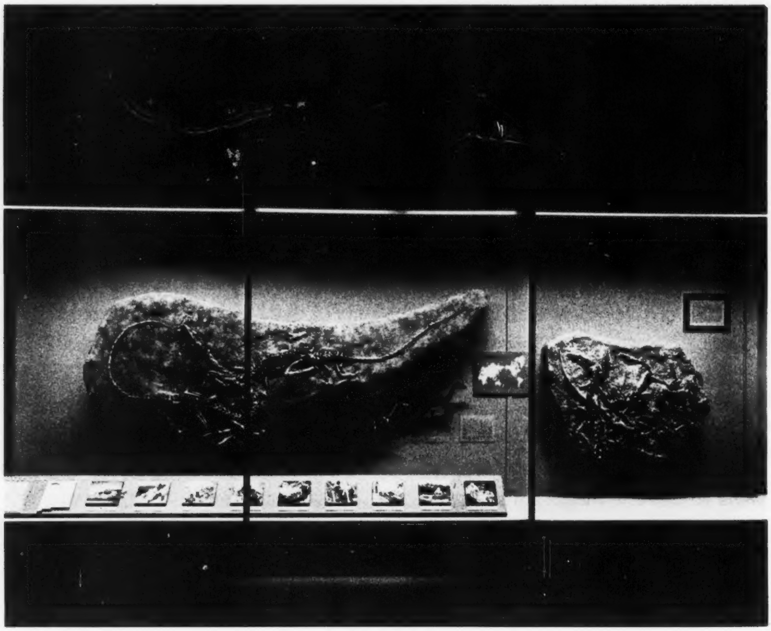
What are the virtues of these chalk murals? The virtues are twofold; first of purpose, and second of technique. To consider the first of these virtues: the murals it seems to us are of particular value because they form an integral part of the exhibition in Brontosaur Hall, while at the same time they are without doubt quite decorative. As a part of the exhibition scheme in this hall they are beautifully adaptable, for they show the salient characters of the dinosaurs and the other reptiles and amphibians on display in a manner that can always be kept up to date. If new facts come to light concerning any one of these ancient animals or its environment, it will be a comparatively simple task for an artist to ascend a long and steady ladder and with an eraser, a sponge, and a few pieces of chalk to bring this part of the mural up to date. In short, the chalk murals are conceived and executed as supplements to the exhibits, and as such they can always be revised with the advance of knowledge.

As for the virtue of technique, the chalk murals are certainly inexpensive, largely because of the comparatively small amount of time

involved in drawing them, and they are unobtrusive, as wall decorations should be. Moreover they are expendable. Thus the chalk murals accord with one of the basic concepts of good museum practice, which is that in an exhibition hall nothing can be regarded as a permanent fixture. When the time comes to revise and refresh our Brontosaur Hall the suffering curator who faces that task can have the murals erased with no great regrets. He will not be burdened with the stultifying thoughts that a great wrong against artistic effort or a great waste of money is involved in removing the decorations from the walls. By then the murals will have served their purpose.

That, of course, is a projection into the future, and we need not worry unduly about such matters now. At the present time we know from our experience that the chalk murals have been extraordinarily effective, not only as tasteful decorations in the Brontosaur Hall, but as aids to an understanding of the exhibits. It seems to one curator that this technique might be used quite effectively in other museums.

Fig. 5. This figure shows how the chalk murals are lighted in part from below, by the top lights of the exhibition cases along the walls.



The Study of Animal Behavior: Its History and Relation to the Museum. I

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Human records show abundantly that anyone who directs his attention seriously towards animals for any reason is likely to become interested in their behavior. Notwithstanding this fact, which has held since prehistoric times, only within the past half-century has society developed methods for representing animals in its museums, not just as effigies or as specimens in formal, didactic series, but as living and functional creatures referred to natural settings. Although an intention to represent animals in action is apparent in many of the surviving traces of man's early artistry, to understand the relatively recent advent into museums of the habitat group and of live exhibits is a problem for the philosopher of museums as well as for the historian of museum exhibition. The development of organized research under museum auspices, focused on problems in the behavior of animals, which is very recent, seems to be a closely related part of this interesting problem.

This subject, still considered tentative and debatable by many, has roots in the history of man and his science so deep as to fall well beyond the limits of the present article. Consequently, our attention is here directed mainly to the phenomenon of departmentalized investigation of animal behavior problems in museums, considered against its historical background.

Human interest in what animals do always involves some recognizable orientation to the practical needs of the times, on the one hand, and to current beliefs and prejudices on the other. From the beginning man's progress in domesticating animals undoubtedly required him to learn

about their conduct, and his improving knowledge about what might be expected of neighboring animals undoubtedly guided his defenses against their real or fancied threats to his welfare and existence. Techniques of hunting, based on such knowledge, were necessary both to man's existence and to his social mores long before they became matters of recreation. When in such vital activities man pitted himself against the beasts, or sought their tolerance or their companionship, the relationships activated not only his tensions and superstitions, but also, in time, other and more cultural concerns. It is interesting to imagine what speculative advances beyond the practical motives of defense and of food may have stimulated the artisans of our primitive cave paintings (Fig. 1A). These paintings suggest, beyond a considerable curiosity derived from knowledge about animals in action, thoughts concerning the meaning of all this for man.

Seemingly, there have always been deeper interests in man's attention to animal conduct, related to his outlook on life and habits of interpreting his world. Abundant illustrations are found in the history of totem, tabu, and folklore, of witchcraft and of metaphysics. Aristotle's "Historia Animalium," "De Anima," and other works involving or touching on what may be called "natural history" reflected long study of records of the past concerning animal function, as well as the enthusiasm of a direct student of animal being and animal ways—the work of a naturalist disposed to combine gleanings from folklore with the results of his own wide observations. Earnest investigator of nature by land and by sea, inquiring into all things as to their growth or "becoming," he developed a pervasive concept of life as progressing from the lower to the higher. For him, the highest faculty was *reason,* which distinguishes man from the mere animal, the creature of impulse. The animal, however, can actualize its inner potentiality, or "entelechy," in appropriate behavior, as an end forecast in its inner being. For this principle Aristotle, as vitalist and teleologist, found much evidence in his information and anecdotes about animal ways. This great philosopher, although limited by his times to mere scraps of information, maintained an attitude of insistent inquiry into the active nature of things and towards the comparison of beings in terms of function.

In the early centuries of the Christian era, the spirit of direct investigation of nature declined, as, with Pliny and others after him, man's sophisticated interpretations prompted indirect approaches to nature in the accumulation of anecdotes about animals and their behavior. This practice, strongly influenced by superstition and folklore, tended to increase the gap between man and nature and at the same time to encourage interpretations of nature that were far more subjective than objective. In the thirteenth century a new era began in biological history, when Thomas

Aquinas and others brought again to the fore the naturalistic works of Aristotle, or at least certain aspects of these writings. In an atmosphere of dogma, however, it was Aristotle's body of "facts," rather than his spirit of inquiry, that became the center of attention. The old statements were now revived with the intention of proving (in the sense of demonstrating but not of putting to the test) the thesis that animals are controlled in their behavior by a divinely endowed, non-rational instinct, rather than by the faculty of reason assigned to soul-possessing man alone. Not until the sixteenth century did the questioning attitude towards nature again become vigorous in the studies of naturalists such as Gesner and Belon. The tendency, then revitalized, to investigate nature directly, rather than by speculation and citation of authority, continued to Darwin and to the present time.

The practice of studying animals directly as whole, active beings did not, however, spring up at once. Although in the few centuries preceding Darwin, explorers and early field naturalists accumulated a considerable body of general facts on the remarkable activities of animals in the wild, such information was treated by and large as relatively incidental, or was overlooked altogether by the principal biologists of the times—the early morphologists, embryologists, and physiologists. In their laboratories and studies they were working on the organism from the ground up, or (better) from within out, and had plenty to occupy them in their young specialties. After Linnaeus launched the science of taxonomy in the mid-eighteenth century with his "Systema Naturae," the conventional criteria for the differentiating and cataloguing of species were morphological, the general method was one of categorical description, and it might be said that biologists in general then adhered more to Plato's emphasis on the animal's "form" or "being" than to Aristotle's concept of the "becoming."

Yet at about the same time Réaumur was carrying out his pioneering observations on insect behavior, including tests of trail-forming in ants, and meticulously recording the results for others to study and improve upon. Also, as an indication of the rise of an interest in function among specialists of the times, who were mainly devoted to studying structure, early eighteenth-century botanists began to investigate not only the physiology but the reactions (tropisms) of plants. Such work, however, was relatively desultory, and, while the question of the animal psyche remained largely in the provinces of philosophers and popular writers, scientists on the whole devoted their principal efforts and attention to subjects other than function and behavior.

It was Darwin who brought the question of the animal mind and related adaptive functions solidly into natural science. Considerations about mental evolution and the meaning of the adaptive activities of animals figured prominently in his "On the Origin of Species," and in

Fig. 1A. A representation of animal behavior by prehistoric man: From among the oldest traces of human art yet discovered, a section of printed mural from the cave in Lascaux, southeastern France, found only recently, in 1940. This work, assigned an age of roughly 20,000 years, is attributed to artists among ancestors of Homo sapiens *overlapping Cro-Magnon man. Throughout this branching cave, the walls bear pictures of a cavalcade of animals, beautifully done in color. In this section, a cow-like animal leaps over the frieze of little horses at the right, considered the work of a different artist, as is the bovine head sketched at the upper right. (Reproduction from* Lascaux: Prehistoric Painting, *published by Skira, Inc., New York.)*

Fig. 1B. A modern habitat group photographed in the Hall of North American Mammals of The American Museum of Natural History. This diorama represents a behavioral situation, typical of moose indigenous to subarctic America, as their autumn mating season advances. Normally forest dwellers, the moose at that time frequently cross territorial lines in the tundra areas and muskeg. When the bulls meet, fierce battles may occur, with alternate cautious approaches and charges, which often result in serious injury or death. These encounters have a complex relationship to mating.

other books a comparative approach was made to the study of structure in its bearing on behavior. A reliance on behavioral evidence for biological theory, as related to anatomical and other evidence, was indicated, for example, in his "The Expression of the Emotions in Man and Animals," in the comparisons he made of muscular structures underlying similar "expressions" and postures in different vertebrates. For example:

> The Anubis baboon (*Cynocephalus anubis*) was first insulted and put into a furious rage, as was easily done, by his keeper, who then made friends with him and shook hands. As the reconciliation was effected the baboon rapidly moved up and down his jaws and lips, and looked pleased. When we laugh heartily, a similar movement, or quiver, may be observed more or less distinctly, in our jaws; but with man the muscles of the chest are more particularly acted on, whilst with this baboon, and with some other monkeys, it is the muscles of the jaws and lips which are spasmodically affected. (Darwin, 1872, P. 133.)

Such methods characterized Darwin's rather new approach to nature. But as much as the Darwinian evolutionary movement stimulated a distinct renascence of interest in the activities and functions of animals, the strong controversial atmosphere of the times turned discussion into debate and stimulated the practice of anecdotalism—simple story-telling—directed at demonstrating the psychological continuity of animals and man. The anecdotalists were motivated dominantly to prove a point rather than to investigate the unknown, so for evidence they were content to rely on fragmentary reports of usually vague origin, and for reliability on appeals

Fig. 1A

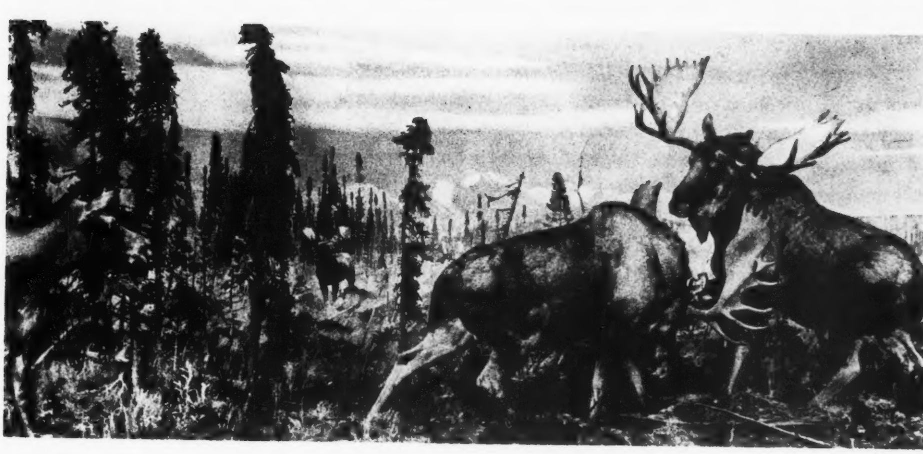

Fig. 1B

to the social standing of the narrator, rather than to checks and balances in the subject matter. They were anthropomorphists by and large, given to interpreting the doings of animals in terms of their predilections concerning man's mental make-up and motivation, who saw fit to support their claims with vague analogies and specious reasoning from general similarities. But, as experiments on human perceptual learning have since shown, limited observation and personal report are notoriously inaccurate (especially when biased) unless subjected to careful controls and reënforced by sound training in the essential techniques.

Neither the practice of anecdotalism nor the scientific reaction to it was new. In the early eighteenth century Réaumur, brilliant mathematician and physicist, also turned his talents to behavioral investigation, and in his treatise on ants interjected a comment on the practice of investigating behavior through anecdotes, as follows:

> Not only Pliny but all the ancient naturalists laud the ants because they honour their dead in the same manner as we honour our own. They assure us that each formicary has its cemetery. It is believed, furthermore, that the dead ant is not carried thither till after it has been placed in a coffin; but that the living do not have to trouble to make one, because empty husks or follicles of certain seeds furnish coffins all but ready-made, among which they know how to choose the most suitable. Ælian tells us what decided Cleanthes to ascribe reason to animals, although he had always obstinately refused to do so. He was an eye-witness of what happened while the corpse of an ant—apparently not one of the common herd—was being borne away. Those carrying the body passed too near the entrance of another formicary, an act which is apparently contrary to the regulations among ants. The corpse was therefore seized by the members of the alien formicary. After several speeches, which the spectator failed to hear but the sense of which he could clearly divine, the corpse was released, but not till after the ants that were conducting the funeral had ransomed the corpse from those that had seized it by the payment of a piece of earthworm. If I report such stories it is surely not with the intention of either rendering them credible or of refuting them, but because they show us the progress of the human mind. What the erudite of former times seriously proclaimed to other savants would to-day scarcely be recounted by credulous nurses to their nurselings. . . .
>
> In a word, the attempt has been made to convert the ants into little men, more perfect than the large ones to whom they have been proposed as models worthy of imitation. It is certainly permissible to regard the ants as small animals of even greater accomplishments if one have need of them in the composition of a pretty and instructive fable; but . . . it seems to me that it is not permitted to naturalists to represent them otherwise than Nature has made them or rather such as we can observe them. . . . (Wheeler, 1926, Pp. 132–133, 134.)

These are not matters of only incidental concern for the historian of

museums, as man's public accounts of the functional properties of objects must always have been strongly influenced by the dominant ideas and prejudices of the times. In the "temples of the Muses" in ancient Greece, the natural objects and artifacts displayed for veneration and study doubtless were offered with a generous amount of folklore and anecdote. Even more probable, natural objects in the cabinet collections of medieval times were likely to have been described in terms of antique beliefs projected through heritages such as the silly and far-fetched anecdotes of Pliny (and that astounding compendium of animal folklore, the "Physiologus") rather than as an expression of the best scientific thought of the age. (Unfortunately for the latter, in no age can the object be depended upon to tell its own story.) Even in modern times, although progress may have reduced the degrees of freedom of anecdotalism in the scientific study of behavior, crude analogy and story-telling as approaches to nature continue as favorite public pastimes and from time to time raise their heads in our newspapers and public institutions, even including museums.

Analogy solely by similarity is always the pillar of anthropomorphism in the interpretation of animal ways, and the degree of license permitted this tendency usually plays a strong role in popular attitudes towards the scientific study of animal activities. It was not mainly Darwin's fault that a popular resurgence of anecdotalism and an outburst of anthropomorphism in scientific as well as in public circles were among the immediate outcomes of his work. To be sure, Darwin's own writings, against the background of the times, contained their share of anecdote and anthropomorphism, yet the development of an objective attitude in studying animal life was another and a far better representation of his contributions. This theme, however, developed its scientific repercussions more slowly than did the other.

The objectivistic reform, distinctly a reaction to the early post-Darwinian anthropomorphic excesses, arose only late in the nineteenth century, with its roots both in the naturalism of Darwin and in general scientific history. Earlier traces of this movement, really the direct forerunners of modern behavior study, were not confined altogether to science. Notably, the great sixteenth-century battle in France over the animal soul involved as principal figures two philosophers, Descartes and Gassendi, who directed their polemic and dialectic *con* and *pro*, respectively. This controversy, which mirrored rather well the political and social tensions of the times, as Rosenfeld's (1941) excellent analysis has shown, also involved men of several other professions, including writers, clerics, a gamekeeper to the king, and a writer of fables. Yet it might be called a draw, in view of the indefiniteness of the rules and the paucity of valid evidence available. One of the most valuable con-

tributions was made by the essayist Montaigne, who carefully evaluated all the evidence at hand and decided, in effect, that the difference was a relative one. In his judgment, man must also be considered a member of the animal kingdom, and not the only intelligent member at that—certainly not the highest in "moral sensibility," as witness his wars, and not the only one with imaginative powers, as witness evidence for dreaming in horses and dogs. As a comparative psychologist, examining the case in depth in terms of evidence for differences as well as for similarities, the essayist was ahead of his time and may be excused the contemporary device of citing cases of devotionally contemplative elephants and tunnies with mathematical insight. In all seriousness, and well ahead of Swift, Montaigne cast man in the role of "Yahoo" rather than of the one rational being, and must have helped at least a few of his readers towards a more critical, objective study of the general problem.

Such influences, unfortunately, did not ward off the wave of anthropomorphism immediately following Darwin's impact. In any case, Darwin's position that "the mental faculties of man and the lower animals do not differ in kind, although immensely in degree" opposed the traditionally strong brute versus man dichotomy on a scientific basis, and paved the way for comparative studies which might disclose differences in kind as well as in degree. Towards the development of an objective investigation of "animal mind," the advance of biological research from Renaissance times also contributed strongly. As Lewinsohn (1954) says,

> Under the microscope the differences between man and animal seemed to vanish completely. . . . For all its multiplicity, nature was one. The theory that the mind, or soul, was something higher than the body ran hard up against the facts of modern anatomy and physiology. (1954, P. 199.)

But diversified answers were offered from science. One was the "mental evolution" doctrine of the physiologist Romanes, who was quite an anecdotalist away from his laboratory and at his desk, postulating for human ontogeny successively higher stages of mentality from that of birth, approximating lower invertebrates, to that of about fifteen months, approximating the mental level of the dog. This doctrine of metempsychoses in series in one generation, so to speak, was a literal application of the mental-continuity principle that made interesting popular reading and was taken seriously by many contemporary scientists.

As an anecdotalist, Romanes was enthusiastic, if not too critical of content. For example, of the cat, he said:

> . . . as one other instance of high reasoning power in this animal, Mr. W. Brown, writing from Greenock to "Nature" (vol. xxi, P. 397) gives a remarkable story. . ., the facts in which do not seem to have admitted of malobservation. While a paraffine lamp was being trimmed, some of the oil fell

Fig. 2. Alfred Russel Wallace, co-discoverer with Charles Darwin of the theory of natural selection, in a scene representing his characteristic interest in the lives and behavior of animals. Having adopted an orphaned orangutan, found in the Malayan forest, Wallace functioned as foster father by giving it rice-water, spliced with sugar and coconut milk, from a bottle with a quill in the cork. In a few trials it learned to suck very well. He "fitted up a little box for a cradle, with a soft mat for it to lie upon, which was washed every day, and the little one as well." Soon "it enjoyed the wiping and rubbing dry amazingly, and when I brushed its hair seemed to be perfectly happy, lying quite still . . ." (However, "at other times," Wallace said, "I had to be careful to keep my beard out of its way.")

The illustration (from Morgan, 1891) shows in the box at the left a young macaque monkey, which Wallace "gave the little fellow as a companion." (Wallace, 1872.)

> upon the back of the cat, and was afterwards ignited by a cinder falling upon it from the fire. The cat with her back "in a blaze, in an instant made for the door (which happened to be open) and sped up the street about 100 yards," where she plunged into the village watering-trough, and extinguished the flame. "The trough had eight or nine inches of water, and puss was in the habit of seeing the fire put out with water every night." The latter point is important, as it shows the data of observation on which the animal reasoned. (1883, P. 425.)

Whatever the possibility for mal-observation in this case, the likelihood of mal-interpretation would seem to have been high. For, although careful experimentation has shown that adult domestic cats are capable under appropriate conditions of effecting simple solutions by reasoning, the probability is much stronger that the highly excited feline of Greenock reacted on another and simpler psychological basis.

It was to promote safeguards of reliability in fact-gathering, as well as logic and comprehensiveness in the interpretation of behavioral evidence, that C. Lloyd Morgan (an eminent psychologist and contemporary of Romanes) brought forward his "Canon," a reasonable rule of parsimony which stated that:

> In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale. (Morgan, 1894, P. 53.)

Morgan, usually more careful than Romanes to know the facts about reported behavioral feats and to assess them systematically, offered numerous examples from his own wide experience to mark out the pitfalls. In one case, he had been trying without any success to train a fox terrier in the best way to pull a crooked stick through a paling fence, but after many trials the dog indicated no particular progress in his behavior.

> Nothing could apparently be simpler than to push the stick up, free the crook, and pull the whole thing through; but the dog continued to pull. I repeated the experiment many times, and tried to show the dog how the difficulty could be overcome. But each time the crook caught, he pulled with all his strength, seizing the stick now at the end, now in the middle, now near the crook. At length he seized the crook itself, and with a wrench broke it off. A man who was passing, and who had paused for a couple of minutes to watch the proceedings, said, "Clever dog that, sir; he knows where the hitch do lie." The remark was the characteristic outcome of two minutes' chance observation. During the half-hour or more that I watched the dog he had tried nearly every possible way of holding and tugging at the stick. (Morgan, 1894, Pp. 257–258.)

It would be interesting to know in what form the passerby transmitted to others his knowledge about the Professor's remarkable dog.

Morgan himself, although favorable to the doctrine of mental continuity, was somewhat reserved on the subject. But to many other scientists, mental continuity spelled "anthropomorphism," and the anecdotal sequel of Darwinism was sure to receive its appropriate reaction: a severe lashing of objectivistic criticism based on research. Towards this movement in the nineteenth century the relatively new experimental psychology contributed, beginning with psychophysics (finding the quantitative relation between stimulus strength and degree of sensation) around mid-century and accelerating with Wundt's psychological laboratory at Leipzig (the first in the world) and with Ebbinghaus' pioneering research on human learning and memory. These events strikingly outlined the possibility of experimenting not only with phenomena of sensitivity and reaction and of learning and recall, but also with other mental processes. Contrary to traditional dogma, the "mind" was now being accepted as a legitimate object of research. To test the psychological problems raised by evolution theory, why not investigate lower animals in these respects, as well as man? These problems of mental evolution never could be settled well by citing anecdotes or by writing non-experimental polemics to prove a favored point.

Within two decades before the turn of the century, scores of investigators in biology and psychology were busy studying the behavioral resources of animals from Protozoa to man. In England in 1882, Lubbock reported the results of experiments and critical observations on insect sensitivity and behavior, and Morgan reported on the behavior, "instincts," and mental processes of birds and mammals. Both of these men, with others such as the protozoologist Verworn in Germany, strongly opposed anthropomorphism as a practice and condemned any reliance on anecdotes in the study of behavior. These investigators, and others, such as the German physiologist Bethe, even more vigorously emphasized the indispensability of experimental methods and of an objective viewpoint in studying the problems of behavior. "Objective" in this context meant a reliance on experimental method and scientific controls in obtaining the facts, and a vigilance against subjective preconceptions and prejudices in interpreting the evidence, so as to overlook or distort none of the relevant facts in the theoretical treatment.

Even before 1900 the naturalistic approach to behavior study had been taken up vigorously in the United States by psychologists such as W. S. Small, who originated the maze method of studying animal learning, and soon notably by E. L. Thorndike, who studied learning with chicks, rats, and cats as subjects, and whose concept of "trial and error" in learning (after C. L. Morgan) eventually influenced international education perhaps fully as much as did the later Pavlovian concept of conditioned reactions. A major criticism was leveled against Thorndike's

methods by Small, W. Mills, and others for the unnaturalness of testing animals in situations so restricted as the problem cages that were used. This matter, with related criticisms bearing on technique, received the attention of an increasing number of investigators as advances were made in adapting laboratory conditions and methods to research on the behavior and psychological capacities of lower animals. The anthropomorphic indulgences of the immediate post-Darwinian period had found their antidote in experimental investigation and theoretical skepticism, although the way to truth still promised to be long and hard.

This movement acquired a strong impetus, particularly in the United States. With the founding of the *Journal of Animal Behavior* in 1911, it became clear that man, in whose attention to animals practical motives and prejudicial ideas had always dominated, at last seriously accepted their behavior as an object of study in its own right. This journal, combining behavioral and psychological studies on a variety of invertebrate and vertebrate animals, carried forward for eight years a vigorous naturalistic advance to which both biologists and psychologists contributed. Then, rather abruptly, the series ended in 1918, and new, complicating developments changed the orientation and content of succeeding journals in the post-war years.

The range and depth of the post-Darwinian development of behavior study are best appreciated in terms of the objectivistic, experimentalist movement expressed in the work of such men as Jennings and Parker in biology and Thorndike and Yerkes in psychology. Although, after the First World War, Jennings turned from behavior to more specific biological areas of study, such as genetics, Parker, to secretory functions and other specialized problems, and Thorndike, to human psychology, Yerkes returned from leadership of the U.S. Army's intelligence-testing program to comparative psychology proper. Yerkes is our best example of the continuity, for, in his active career spanning the first half of this century, he made contributions clearly marking out the Darwinian sequelae in scientific behavior study. By following some of his representative publications chronologically, we see that in his life program he literally mounted the phyletic and psychological ladders, as follows: 1901, reactions of Daphnia, learning in the turtle; 1902, habit formation in the green crab; 1903, habits and reactions in the frog; 1904, behavior and reactions of medusa, and space perception in tortoises; 1905, hearing in frogs, and facilitation and inhibition in the reactions of frogs; 1906, behavior of coelenterates; 1907, behavior and psychology of the dancing mouse; 1909, behavior modifiability in the dancing mouse; 1911, methods of studying vision in vertebrates; 1912, learning in the earthworm; 1915, comparative studies of intelligence in birds and mammals (multiple-choice method); 1916, mental capacities of lower primates; 1917–1921,

army intelligence-testing program; 1921 and thereafter, primate psychology (Yerkes and Yerkes, 1929). From these years until his death in 1956, Yerkes was active in promoting the investigation of primate psychological and biological functions. Clearly, he was foremost among those whose studies served to give evolutionary theory a sound basis in psychological research. It was he especially who demonstrated that, in their behavioral and psychological capacities, animals throughout the phyletic series may be compared validly in terms of both similarities and differences. From such work it is clear that, as between lower primates and man, the predominant note is one of relationship and continuity, notwithstanding man's wide leadership in psychological capacities essential to language, conceptualization, and, particularly, social heritage.

Zoological museums had been developing as scientific institutions with the rise of biology and reflect in various ways and to varying degrees the stages of growth in scientific biology. These changes seemed indicated significantly in the field representation of museums. Bates, Belt, and Hudson, who were collectors for museums, and many others carried into the field around the world an objective approach to nature that exemplified the scientific advances of their times. These men were interested in the natural situation and activities of animals as well as in their structures and classification when collected. In contrast to their predecessors of the "cabinet" period, they showed in their writings an endeavor to observe, investigate, and carefully report nature as they found it. They, as well as the curators at home, lived more or less under the influence of developments in science that centered increasingly around function as a key problem in the study of nature. Although the rise of taxonomy seemed to emphasize structural bases for classification to the exclusion of nearly everything else, this discipline inevitably felt the influence of morphology, which was developing as a science increasingly aware of the need to study animal structure in its relation to function.

Other scientific changes also played their part, including especially the revival after 1890 of the organismic theory through the work of biologists such as C. O. Whitman. Another was the advancing subject of embryology: the closer relationship of anatomy and physiology inevitably increased interest in the development of individual structures and functions as interrelated. Emphasis on the function of the organism as a whole in physiology and other branches of biology promoted a new discipline, ecology, devoted to the investigation of the environmental relationships of the organism. In the literature of this period, many important instances are found of an increasing emphasis on the integrated study of animal structure and function. As one example, W. M. Wheeler's classic "Ants, their Structure, Development, and Behavior," published in 1910, symbolized the work of a man who, after having received a doc-

torate on an embryological problem, had entered upon a versatile scientific career centering around taxonomy and museum curatorship (including a period in The American Museum of Natural History), but extending readily into studies of function and behavior.

Modifications appeared meanwhile in the museums themselves, meriting specialized historical study in relation to the times. To be sure, the influence on museums of scientific advances seems on the whole to have involved an appreciable latency; to what extent, and on what basis, only historical study will reveal. Most intriguing of the changes, perhaps, as reflecting a growing tendency for a representation of the functional relationships of the organism, is the habitat group or diorama. This striking exhibitive device reified the animal and its behavior for the museum audience by the mounting of the individual animal or group in postures that suggested a typical action situation in nature, by the introduction of third-dimensional techniques to heighten the impression of living beings existing in space and time, and by the merger of the foreground into a painted background for a broader suggestion of the natural relationships and biotic zone of the animal. The idea of the habitat group seems to have developed slowly, in part as a heritage from the earlier period of nature-pioneering in America. In essence, these characteristics are reported to have been used in a museum of nature privately set up by the American artist Charles Willson Peale, shortly after 1800. By 1900, exhibits of this general type appeared in various museums on both sides of the Atlantic. In The American Museum of Natural History the full technique of the habitat group was utilized in a series of bird displays, the first of which, the "Bird Rock Group," was presented in 1900. This series of exhibits represented birds, indigenous to very different parts of the world, in their life and behavioral situations. Emphasis on function had grown apace. In these new exhibits, and in comparable ones concerning other animals, soon to follow, man's progressing insight into nature became translated into vivid representations of animals functioning in their species niches.

In the new era, this Museum's representatives in the field went out not only as collectors, but also as investigators of animal life. In the *Bulletin* of 1892, the change was signaled by an article by F. M. Chapman, then in his fourth year as Assistant Curator of Birds and Mammals, which reported a study of these vertebrates found in the locality of Trinidad, Cuba. Careful notes were added to the taxonomic descriptions, on the flight, nesting, and song of the birds, and the habitats and activities of the mammals. The attitude was clear: a collector's report could not be considered complete without some substantial information concerning behavior.

From the early days, this Museum has had a strong tradition of func-

tion-and-behavior study in the zoological departments as well as in anthropology. W. M. Wheeler, Curator of Invertebrates from 1903 to 1908, never collected ants in the field without close attention to the details of behavior. Chapman's work on the bird dioramas revealed the fascination behavior held for him, an absorbing interest which developed into specific field studies. In several books (e.g., Chapman, 1929) and in articles in *Natural History* he reported the results of field studies directed at the resources of behavior in both birds and mammals. He carried out both systematic observational projects such as his survey of the tropical social bird, the Oropendola, and actual field tests of behavior, such as his work on booty-finding in the vulture. Comparably motivated was F. E. Lutz, Curator of Insects, who went into the field both as collector and as experimentalist, to make pioneering investigations on problems ranging from insect sensitivity and responses to ultra-violet and other types of stimuli to a variety of problems concerning general behavior. These included questions such as how certain insects and birds are awakened to their daily routine, and the relationship between body structure and burden carried by the polymorphic workers of a leaf-cutter ant. Lutz's experimentation also extended to indoor work, both in his basement at home and in his laboratory at the Museum, where he made controlled experiments on such problems as the basis of day-night activity rhythms in crickets and other insects. There, too, he maintained a variety of living insects, from Orthoptera to ants, in artificial nests in order to study their development and their behavioral repertoires.

A staff member of similar interests was G. Kingsley Noble, who in 1920 became assistant curator, administering the Department of Herpetology. As were Chapman and Lutz, Noble was a taxonomist who was also interested in studying the whole animal, alive and functioning, as well as in the form of a specimen. Not disposed to confine his life studies to taxonomy and collecting, Noble began by maintaining rare tropical frogs and salamanders in the laboratory, where he induced them to breed and was able to study their life histories and activities. As his department grew, its work extended from taxonomy to investigations of structural and functional relationships, and to animal ecology. For him, descriptions of structure and behavior were only the beginning of the biologist's task, and he pressed on to investigate problems considered fundamental: mating and other aspects of sex behavior, the functions of hormones in structural development and behavior, and aspects of social behavior.

Noble's interests in structure led him from the anatomy of a species into its histology; his interests in function led him from studying the role of mechanisms, such as the adhesive toe-discs of tree frogs, to problems in the evolution of adaptive structures in general, as means of

working out principles underlying the relations of animals to their environments. As with Chapman and Lutz, but much more intensively and extensively, his investigation of nature moved from descriptive methods to the working out of analytical techniques designed for wider inductive attacks on the problems (Noble, 1941). In exhibition, similarly, he soon advanced beyond the descriptive stage, for he believed that:

> The curator's task only begins with the habitat group. He must in supplementary exhibits dissect and analyze nature in such a way that the public will understand the principles controlling the life of the creatures portrayed—the fundamental biological principles controlling life in general. (Beach, 1944.)

So Noble's exhibits on animal behavior covered a wide range of problems,

Fig. 3. Rat learning a maze to the advantage of public interest and information, in the Hall of Animal Behavior set up in the first floor of the African Wing of The American Museum of Natural History during the late 1930's. This hall, planned by Drs. Noble and Beach, contained a variety of three-dimensional exhibits showing phenomena and principles of the adaptive behavior of animals.

from the role of the sense organs in the behavior of fishes, birds, and mammals to tests of mammalian learning involving animals running mazes in full view of the visitor (Fig. 3).

A museum that sponsors such research activities and organizes exhibitive procedures so advanced pedagogically certainly has come a long way from the cabinet and curio collections of earlier times. Of course, as the twentieth century advanced, museums, as conceived by many persons over the world, continued solely as repositories of natural objects, their program confined essentially to the display and classification of these objects. In many of these institutions, however, the business of the curators had expanded from the care, description, and classification of specimens to include the study and explication of their function. Previously, behavior had been inserted incidentally, if at all, in the collecting and taxonomic reports, in the form of fragmentary, scattered references to "habits" or "instincts," by which was meant, simply, "activities typical of the animal." In the early days, such information usually was the result of very casual observations and was reported rather incidentally. But function and behavior, in the hands of the curators we have discussed, became important as goals in the study of the organism. These men perhaps characterized the period in which Theodore Roosevelt had lambasted exploiters and those who misrepresented nature as "nature fakers." In their own contributions they exemplified the basic necessity for reliability and validity in the study and explanation of natural events. Accuracy in the description of structure and the determination of taxonomic status is but one step, moreover, towards the goal of understanding nature, and, if the principle is well mastered, it will be extended (although not easily) to function and behavior as well.

Our own period has faced the need for specialization as one of its trials in science, as well as in other professions. At the same time the crossing of professional lines is urged upon us by a deepening study of relationships among different fields. In the museum, as naturalistic evidence and theory on each type of animal enlarge in scope, and the tasks of collation and study increase, the corresponding departments of specialization must focus still more on problems specific to their respective animal groups. But also, as science grows, the several departments must widen their horizons to consider problems of functional relationships extending beyond their own animal specialties. The task is a very demanding one, and even in museums with the best of resources, not all members of every specialized department can go very far in applying themselves to broad problems along inter-phyletic lines. In the earlier days only a few, such as Chapman and Noble, had much time for intensive study of common problems in adaptive function and evolution.

The growing need, expressed by these curators, was to find better research tools and appropriate animal subjects in order to realize the unique potentialities of museums in the effective investigation of such problems.

The history of one department illustrates the growth of this aspect of the Museum's work in the investigation of phenomena accepted as fundamental in natural history: adaptive function, speciation, and the evolution of behavior. With its increasing scope of experimentation in focusing on such problems, Noble's department in 1928 had "and Experimental Biology" added to its name. In 1934 it became two separate departments. The range and depth of research had advanced well beyond the earlier departmental lines, held as they were to taxonomic and other problems specific to two lower vertebrate classes. So the new department had to be fitted with laboratories equipped for the investigation of broad problems of biological function and behavior by modern techniques, with animals from fish to mammals as subjects. In the words of Frank Beach (1944), under whose chairmanship after Noble's death this division became the Department of Animal Behavior,

> Objective and quantitative analysis of complex behavior patterns cannot be accomplished merely by assiduous and painstaking observation (as) . . . observational and descriptive methods are no longer sufficient in any branch of science. The determination of the basic causes of behavior rests upon a genuinely analytical approach (necessarily involving) not only the general fields of zoology and biology but also . . . psychology, physiology, neurology, endocrinology, etc.

This department, devoted to the investigation of broad phyletic principles underlying behavior patterns and their evolution, is in no small part a contribution of those curators in the specialized departments of this Museum, who, from the early days of the institution, had shown a devoted interest in the observation and description, and also to an appreciable extent the testing, of animal activities.

One point in particular is clear from the experience of these men and others who began their museum work essentially as taxonomists. Curators in the special fields, in their research, must make inferences from structure concerning behavior, often of remote or historically extinct animals. But the inferential, theoretical path from structure to function and behavior is seldom, if ever, as direct as it may seem at first sight, and in any case the inferences from structure must be tested away from the desk. What is more important, the inferences and the hypotheses must be tested by sound techniques—with adequate experimental set-ups, instrumentation, and controls—and the results must be evaluated in terms of comprehensive theory. Not all these necessary instruments may be readily accessible to the specialist in taxonomy or to the biologist whose research has been devoted to certain specialized aspects of one group

of animals. In our time, behavior has become a major category of natural history for scientific study, and its problems can be attacked adequately only through the cooperation of numerous disciplines and the use of many tools in science.

(*This is the first of two articles on "The Study of Animal Behavior."*)

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The Time and Place for Experimentation in Museum Design

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We are all loth to grant to others the privileges we claim for ourselves. And perhaps it is unreasonable to expect that modern science, born of the experimental method, should show a generous attitude towards the need to experiment in other fields of creative intellectual effort. Nevertheless it is disturbing to find experimentation in design a constant target of curatorial attack in nearly all natural history museums trying to seek better communication with the public of today, through new forms of exhibition in tune with our times. The problem is one of making fair allowance for experimentation by both designer and curator and of establishing in each an amicable respect and understanding for the experimental needs of the other.

Experimentation run wild is no more desirable than for a museum to remain forever within the esthetic and intellectual concepts in which it was originally founded. Even experimental effort must be rationally planned and allocated, with time, place, and nature of subject taken into account.

Museum designers operate on two levels in their cooperation with curators and preparators. As architectural designers they plan the entire form of an exhibition hall and the appearance of all its structural elements. As display designers they concern themselves with the arrangement of discrete objects in each exhibit in a suitable milieu of colors and shapes.

At the display level, the designers often have to deal with physically small but esthetically subtle and intricate problems that are little appreciated by those not trained to understand them. The problems tend to

be unique and therefore not capable of solution by the application of already established principles. Opportunity to experiment is essential.

One of the greatest difficulties of museum exhibition springs from the fact that the objects on display have been removed from the natural environment with which they had previously attained harmony, whether by biological evolution, the artistic ability of their human creators, or merely by the passage of time and the growth of tradition. In the museum a new and different kind of harmony must be created by artificial means to replace the one that has been lost.

In the habitat group this is achieved by carefully reproducing the original harmony of the natural setting, and the designer has virtually no function at the display level except with reference to labels and similar accessory items. But when the objects cannot be placed in a realistic image of their previous surroundings, the esthetic success of the exhibit depends entirely upon the designer and the preparator's execution of the design, just as the intellectual success depends upon the curator, and the educational success upon the happy integration of the efforts of both. To function effectively, designer and curator must each have final responsibility in his own field of competence. The designer cannot be allowed to distort intellectual contents or emphasis by his art. Nor can the curator be allowed to be the final judge of artistic merit when intellectual content is not involved in a choice. As the precise boundary line can never be clearly marked, an independent arbiter is often required, and this function normally falls to the director in person, or, by his designation, a qualified moderator. As pointed out by Witteborg,[1] the ultimate performance of an exhibit depends upon the standards employed in the visual presentation of the factual or conceptual material provided by the curator.

Much of the sculpture ornamenting Mayan structures was carved in a rather leprous-looking rock. In their original setting, they were surrounded by the same, or by harmonious, materials. Detached and removed to a museum, they present esthetic problems for which a solution had to be found in our own Mexican Hall. The carved head of a deity (Fig. 1) was used as an experimental object. Textiles and building materials of various finishes were tried for surrounding texture. But their smooth or too regular surfaces made the head look like a bad case of acne portrayed in stone. As it was generally agreed that this was not the effect intended by the artist, the experiments continued until only the unfinished rough sides of the materials remained to be tried. These turned out to offer the perfect solution, absorbing the excessive visual

[1] Witteborg, Lothar P., *Design Standards in Museum Exhibits*, CURATOR, V. 1, #1, January, 1958, P. 41.

impact of the crudeness of poor rock surfaces in unnatural indoor surroundings into the irregular rough texture of the entire field of vision. Once selected by tedious experimentation, the material could then be used in the display of other objects of similar quality with great savings of time and effort.

Many, but very far from all, display problems call for solutions which in the end look so simple, natural, and matter-of-course that it is very hard to realize that the answer was not at all as obvious as it may seem afterward. This is a fact that those who wish to discuss the merits of experimentation in design should be very careful to bear in mind.

The example of the Mayan head is a simple illustration. One of greater complexity was a tree of life (Fig. 2) presented in three dimensions in one of our new paleontological halls. The production of an esthetically pleasing form to convey the complicated message of this exhibit in a clear and simple manner involved a great deal of experimentation and creative artistic design. Actually, the form itself became such an attractive example of non-objective sculpture that it seemed almost a pity to have an educational message draw a veil over its inherent artistic quality. Let it not also draw a veil over the search and effort that went into the development of what we see today.

The Mayan head and the tree of life were single-object problems, although the solutions can afterward be generalized for many situations of a similar kind. When dealing with single objects, it is rarely profitable to treat experimentation and final execution as separate operations. The object itself is used in the experiments, unless it is unusually delicate or of exceptional value. The most successful result of experimentation is in itself part of the final execution and may sometimes become the entire finished product.

When the design problem involves the arrangement of many different objects in a single display, there is better reason to weigh the advantages of a physical and administrative separation between experimentation and final execution. Scale models and mock-ups are the most effective tools of separate experimentation. The use of scale models in exhibition concepts has been so well presented and illustrated by Henry Gardiner in the first issue of this periodical that there is no need to dwell upon the method here. But some discussion of its economic and practical advantages or disadvantages is still in order. Small-scale models need not concern us in this connection. But large-scale models and full-size mock-ups raise serious questions about the actual net gains derived from their use. Such models and mock-ups will be found to be far from inexpensive under any system of true cost accounting. And a good deal of the work that goes into large-scale or full-size experiments could commonly have survived the experimental changes, if the experiments

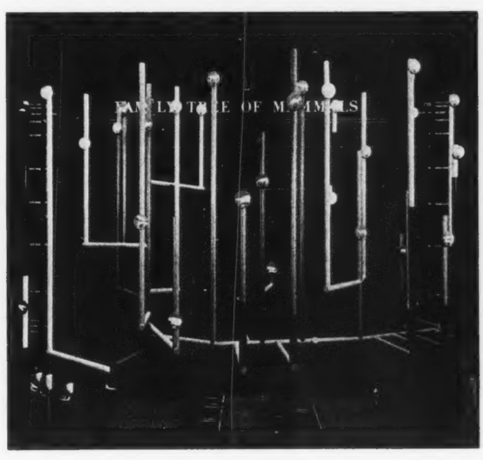
had, from the start, been incorporated in the progress of the final execution of the exhibit. We are all familiar with mock-ups that have ultimately been carried to the point where final execution in the exhibition hall becomes, in large part, an actual duplication of work already done in other quarters.

The value of separating large-scale experimentation from final execution must therefore be carefully examined in advance on the merits of each particular case, and no administrator can accept the dictum that experimentation has no place in the final work of installation of a permanent exhibition hall. An extremely simple and obvious case may serve to illustrate the point.

The texture and color of certain objects made it difficult to determine the most favorable background color without the actual objects and the actual conditions of illumination under which they would be seen in the finished hall. The designers, therefore, first had the background painted according to their best advance judgment. When the specimens were put in place, the color proved to be not the best that could have been used. To apply the correct final color, the specimens had to be taken down again temporarily. This experiment in the progress of final installation involved an extra cost of less than fifteen dollars, plus the inconvenience of an extra handling of the specimens. To conduct the experiment separately elsewhere, with an adequately simulated final illumination, would have cost not less than five hundred dollars, and would have involved far more handling of specimens. Nevertheless, the operation

Fig. 1. Mayan Head.

Fig. 2. Three-dimensional tree of life.

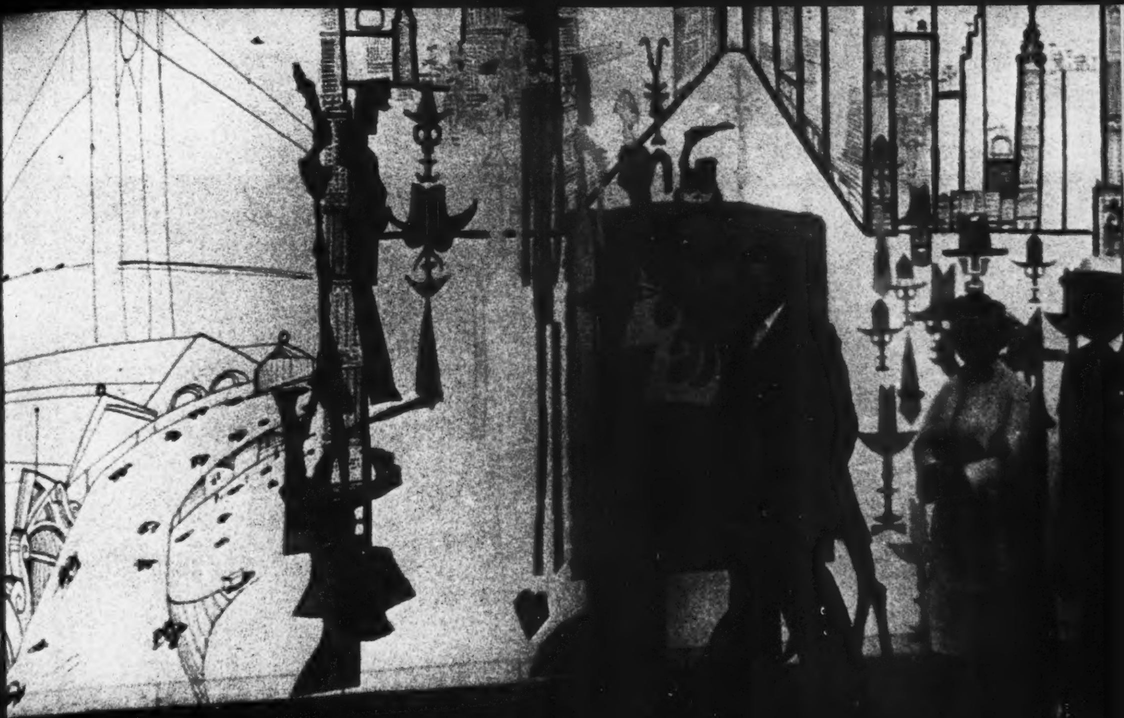


became subject to violent curatorial criticism and herein lies a great danger.

Unreasonable criticism of experimentation done under a curator's eyes in the installation of a permanent exhibition hall may tempt the designers to use otherwise unwarranted mock-ups as costly hideouts from unsympathetic observers of their struggles with the problems of design. I have little doubt that this is at least a subconscious element in the causation of a sometimes excessive use of large-scale models and mock-ups.

On the architectural level of museum design, where we are concerned with the layout of an entire hall and the physical appearance of all its major units, the value of experimentation with scale models is beyond dispute and justifies considerable expense. But here we also get assistance from another source, namely, the temporary exhibit. In the temporary exhibit we have opportunity to experiment with future forms, without committing ourselves to the results of our experiments, while still being able to expose them to public reaction. And opportunity creates obligation.

We must not forget that even in the permanent exhibits we work on today we must strive for the forms of tomorrow, if they are not to be "dated" before the halls are opened. In a natural history museum it may take five to fifteen years to complete a hall. It is therefore logical for us to aim our temporary exhibits not even at the forms of tomorrow, but towards those of the day after tomorrow, so that, in navigator's terms, we can at least get one "fix" to guide us to the forms of tomorrow in our permanent exhibition halls.



CURATOR

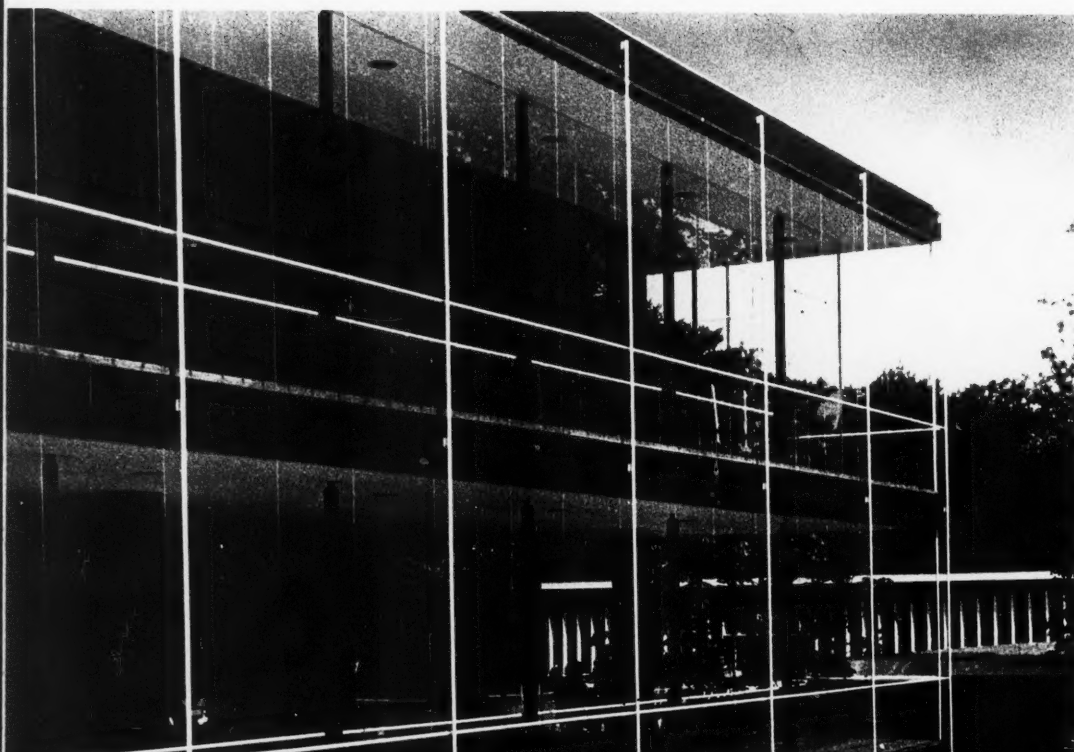
looks at "Expo '58" . . . and makes some last-minute observations on the eve of the big show's closing.

The first postwar world's fair which opened in Brussels this spring offered a unique opportunity for comparison and evaluation of international design trends, and much of interest to museum display artists. In evaluating the various national pavilions, CURATOR looked at them in terms of general architecture, the story being presented, the use of new and imaginative exhibit techniques, and the craftsmanship employed in the total construction. These characteristics were then considered in relation to the overall effectiveness of the pavilions.

Neither the United States nor Russia emerged as outstandingly successful exhibitors by this method of rating. Since the press has given more than adequate coverage to these two giants, it is more profitable to turn to the interesting and successful pavilions of the smaller powers. After a week of repeated visits to all the pavilions, CURATOR is convinced that the West German and Swiss entries deserved top honors.

The West German architects Egon Eiermann and W. Rossow utilized their wooded hill site to advantage by placing eight small pavilions connected by covered bridges around the beautifully landscaped grounds. The buildings were in the clean, linear, International style, and looked

Part of the famous Steinberg mural in the American Pavilion.



Beautiful construction and lightness of feeling characterized the German Pavilion.

like luminous jewel boxes with their generous use of glass against the verdant setting. The main theme of the Exposition was "Man and Progress," and the German designers interpreted this to mean that the technical and scientific achievements of our age are worthwhile only if they help men collectively and individually to achieve a better life. Economic and trade aspects were minimized, and emphasis was put on the realities of everyday life—work, leisure, community, family. The different surroundings in which the German people live today were well shown with photomurals and models of new housing areas. A giant floor map, covered with a raised sheet of glass, enabled visitors to walk over and look down upon a panorama of towns and cities. The extent to which scientific progress has increased possibilities for happiness pervaded each section of the pavilion. Imagination--but with great restraint—was employed in the exhibit design, giving it a clean-cut, stimulating appearance. The choice of materials and the general construction details achieved a unity of design. Cases, objects, and graphic design elements had a meaningful relationship to one another, so that the story was successfully told.

The Swiss Pavilion, designed by architect Werner Gantenbein, was both highly original and functional as an exhibit hall. It consisted of 42 hexagonal sections grouped in honeycomb fashion around an artificial lake with a smaller section of five hexagons facing it across an avenue. While the exterior was handsome, it was the elegant interior design which was outstanding. In keeping with the Fair's theme, major emphasis was placed on the fundamental structure of the Swiss way of life, the way in which humanitarian achievements and technological progress have improved living conditions. Exhibit design in the Swiss Pavilion was characterized by simplicity and excellent craftsmanship. The spaciousness of exhibit areas permitted efficient flow of visitors and avoided the bottlenecks which characterized so many of the other buildings.

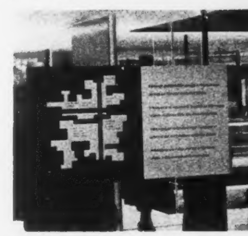
As has by now been so often observed, plaudits for architecture alone go to Edward Stone for his United States Pavilion, an extremely impressive structure—though not very practical as an exhibition hall. Architectural praise also is deserved by V. Richter for the Yugoslav Pavilion, and R. Vasquez Molezun and J. A. Corrales Gutierrez for the Spanish Pavilion. The Yugoslav Pavilion achieved a look of transparent lightness through the use of glass façades, delicate steel framework, and cantilevered overhangs which made it seem to hover over a sunken garden and pool. The Spanish Pavilion used light, yet bold, architectural design to create a striking impression of a forest of steel trees. Finland and Czechoslovakia deserve mention for the imaginative interior display features of their pavilions.

On the other side of the ledger were some bitter disappointments. Italy, which for years has been a leader in display design, seemed to have

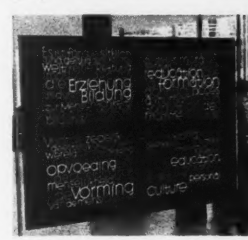
Continued on page 46

The German maps . . .

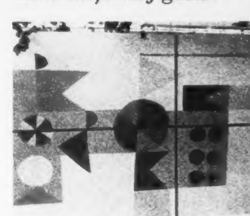
photographs . . .

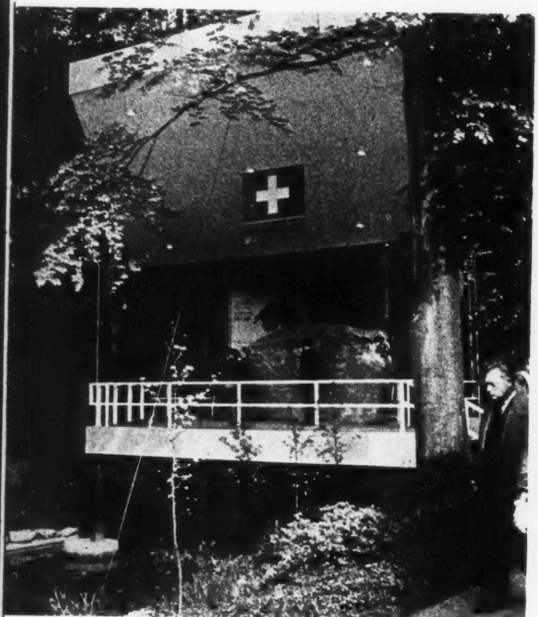


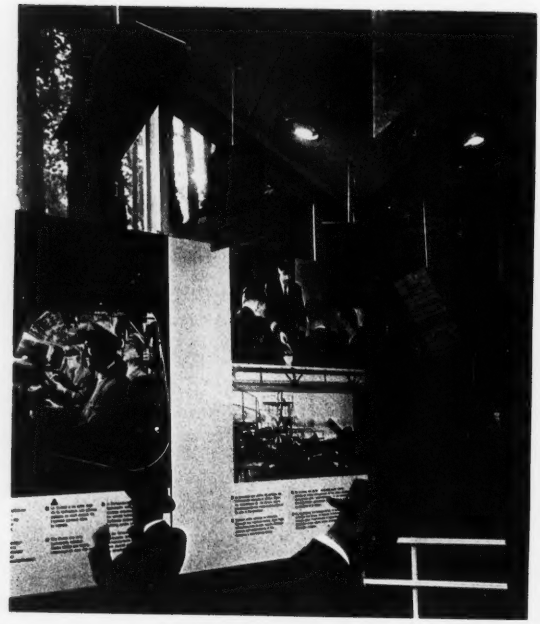
graphic art . . .



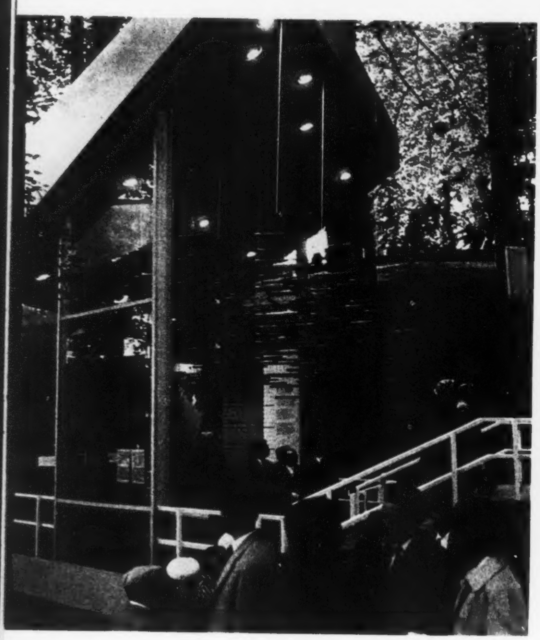
were uniformly good.

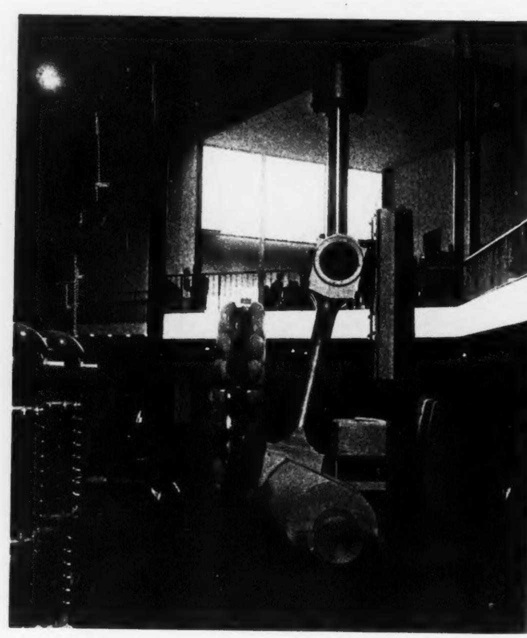






Rural setting of the Swiss buildings . . . *made an unusual backdrop for exhibits.*





Models of the Swiss merchant marine . . . *contrasted strikingly with the machinery display.*

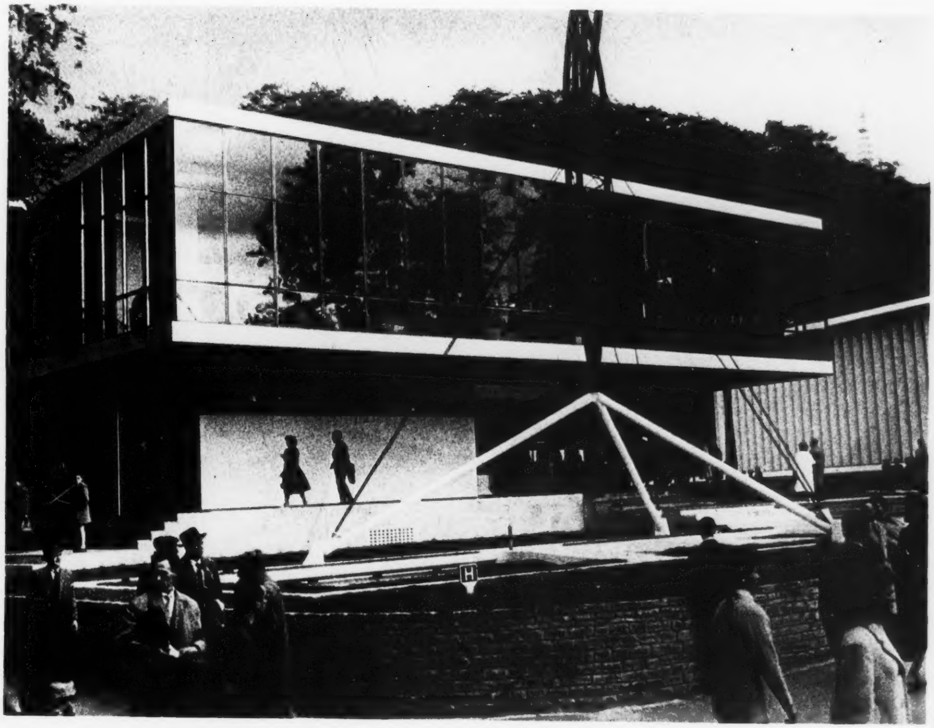
Spaciousness of exhibit areas was an outstanding virtue of the Swiss Pavilion.

Unusual arrangement of the large photo-murals attracted much attention.

Photographs combined with painted figures decorated the walls of the Czech exhibit.

reverted from its brilliant experimentation to a form of medievalism. At least that is the impression given by the team of nine architects who designed the Italian Pavilion. Their heavy bleak buildings with few windows looked almost prison-like on the side of a picturesque hill. The interiors were made ponderous by the use of opulent velvets, heavy wrought iron fixtures, huge ceiling beams, and rough stone floors. Only a few areas were reminiscent of the simple elegance that usually characterizes Italian design.

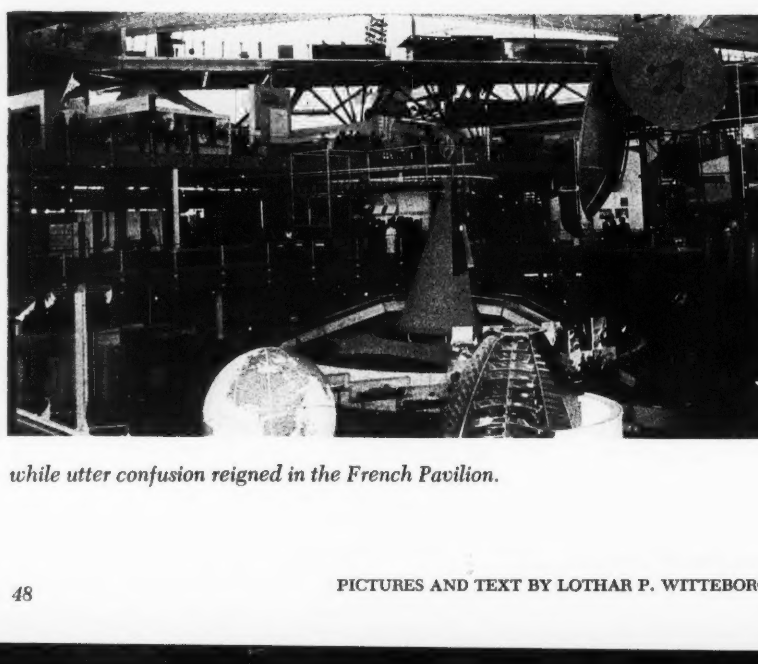
A remarkable exercise in bad taste was the French Pavilion designed by architects G. Gillet and P. Sourel. It could appeal only to a civil engineer, who would marvel at the feat of balancing fourteen thousand square yards of pavilion on only one point. The hulking structure managed to encompass two unfortunate extremes: vast waste space in its lofty rafters and cluttered crowding on its floor area. Every kind of display gimmick and every product made in France were jammed into this monstrosity, which must have added greatly to the French national debt.



Another example of the "floating" pavilion—the Yugoslav building.

The unique structure of the Spanish Pavilion suggested a forest of trees.

The Italian exhibition building was prison-like in its heaviness . . .



while utter confusion reigned in the French Pavilion.

PICTURES AND TEXT BY LOTHAR P. WITTEBORG

Qualifications of a Teacher in a Large Museum

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The evolution of natural history museums has been from loci for the collections of taxonomic workers to interpretive educational centers, or, in the case of The American Museum of Natural History and other museums like it, to huge multi-purpose academic institutions. The staffing of modern natural history museums with properly trained and qualified educators has, as a result, been one of the growing pains of modern museumdom. For example, what a teacher may be called upon to do in one museum may not correspond to the duties of a teacher in another because of the diversity of activities of the many museums. Another aspect is the range of duties that a teacher in any one museum may be called upon to perform *with competence.* Let us consider, as a specific example: (1) the activities of the teaching staff of the Department of Public Instruction of The American Museum; (2) the qualifications such instructors should have in order to perform their duties satisfactorily; and (3) the question of where such teachers are to be obtained and how they are to be retained.

At present the department has some twenty instructors, senior instructors, and supervisors on its staff, with some additional positions, presently vacant. By far the department's largest program is the New York City school program, in which all instructors and senior instructors teach school classes which come to the museum by appointment. On an average day, fifteen or more such classes (mostly in the elementary grades) are instructed in the exhibit halls in topics ranging from primitive crafts through conservation to evolution. It is a fundamental philosophy of the department that each teacher be as scientifically accurate as pos-

sible, even though he must be expected to teach as wide a variety of topics as "Conservation," "Prehistoric Life," "The American West," "The American Indian," and "Plants and Animals of New York State." Furthermore it should be noted that he or she is handling children of elementary school grades from all possible kinds of background and ability (including occasionally mentally retarded and physically handicapped children).

Besides the extensive school program, there are at present twelve adult courses offered at the museum during each academic year, for which credit is given towards graduate degrees in education in an accredited institution. For this program the Department of Public Instruction bears the full weight of responsibility. About a third of the teaching staff of the department teach these courses. The courses are for the benefit of New York City teachers and graduate students in education, and are of two types: (1) general survey courses of subject matter, and (2) educational techniques courses.

In addition to the above programs there are also occasional guided tours, two weekly programs at the secondary school level, a program of special lectures for student nurses, and other specialized activities. These last, however, constitute a minor portion of the department business compared to the teaching at the elementary school and graduate levels.

Let us now consider the training that would render a teacher fit to undertake his job *with competence*. For its purposes, the department recognizes two major areas of natural history: social studies (anthropology) and natural science (plant and animal life and geology). Each teacher works mainly in one area, although he is expected to be able to handle a few topics in the other. If he works in anthropology, he must be familiar with the cultures of the Eskimo, various African peoples, Indians of North America, Central America, and South America, and the peoples of Northeast Asia and the Pacific. He must also, of course, understand the basic anthropological principles. These demands would seem to call for at least a bachelor's degree in anthropology, and preferably a master's.

The natural science teacher must teach general topics on plant and animal life on several grade levels. He also teaches topics on conservation, prehistoric life, and the history of the westward expansion. This last subject is assigned to the natural science teachers because it requires a knowledge of the geology and animal and plant life of the American West. A knowledge of plant physiology, plant taxonomy, life histories of many animals and plants, general geology, agronomy, paleontology, American history, general ecology, and the principles of conservation are of the utmost importance to a natural history teacher. Certainly the equivalent of a bachelor's degree in biological sciences would be a minimum academic preparation for such work. A master's degree would

be preferable, so that the necessary range of background courses can be obtained.

In addition to achieving a sufficient level of competence in all the facets of his area of emphasis, a museum teacher must be able to ascertain the learning ability of any class, from grade three through grade nine, within the first few minutes of contact. Such learning ability would depend upon the intelligence, experience, home discipline, school discipline, and emotional stability of the class as a whole and the members separately. For this reason, training in general psychology, educational psychology, and sociology and years of teaching experience are necessary for the teacher. If a class happens to be a non-English-speaking class from a Puerto Rican section, and there are many such at the present time in New York City, a thorough knowledge of colloquial Spanish is helpful.

The native talents of a person as a teacher (not measurable by any known means) must be taken into account. Such subtle devices as gauging mood and comprehension of a class by their eye expressions, knowing when to move to another exhibit when shifting feet and drifting attention so indicate, and recognizing the indefinable saturation point for a lesson are all part of the fine art of teaching which can be built by training and experience only upon the solid foundation of natural ability.

Let us now add to all this the problem of presenting an adult course. A high degree of authoritativeness is essential in order to maintain the academic standards required of an accredited institution. It is not enough to have a good general background as well as training in education. The teacher must have achieved some level of specialized proficiency so that he can speak with authority to his students. In most cases, independent field study would provide that authoritativeness. Indeed, field experience might be considered an essential supplement to academic training for all levels of teaching.

Now, how does the Museum obtain and hold the teachers to meet its needs? Many graduate students accept positions on the department staff while studying evenings towards their degrees. Such teachers are generally transitory department members, accepting better-paid positions elsewhere after completing their studies. To those who wish employment on a more permanent basis, the department offers an atmosphere of considerable freedom. Opportunities to attend professional and scientific conferences are provided. Easy access to current scientific literature is afforded through the Museum library. Independent field work is encouraged. Such policies are possible to varying degrees in other museums as well.

Perhaps the greatest problem confronting natural history museums is that of paying their teachers. The American Museum is perhaps some-

what better off than many other museums in this respect, for the City of New York now provides the funds for this purpose. When one considers that an American Museum instructor earns a starting salary of roughly a thousand dollars per year less than many secondary school science teachers in the state and a top salary of about three thousand dollars less, and when one considers that some smaller museums must pay their teachers starting salaries of as much as five hundred dollars less than an American Museum teacher receives initially, the outlook for obtaining highly qualified teachers for natural history museums generally is rather dark. The saving grace, it would appear, is the opportunity for wide experience and the liberal atmosphere not ordinarily provided in many other kinds of positions.

In summary, what the American Museum of Natural History, as a large natural history museum, faces today is a problem of three principal aspects, with respect to its teachers: (1) what are its teachers' duties in the large and active educational program; (2) what qualifications must those teachers have in order to fulfill their professional obligations; and (3) what steps can be taken to obtain and keep teachers of high caliber? Members of the teaching staff must teach a wide range of topics to school classes of a wide range of grade levels, backgrounds, and abilities, and at the same time be prepared to teach a course at the adult level at standards required for graduate credit by an accredited institution. Such work requires a wide background, a high degree of competence in a particular field, and talent, training, and experience in education. At present at least a bachelor's degree is called for, and a master's degree is preferable. Even a person holding the doctor's degree would not be overqualified. Field experience is an added necessary qualification for those teaching the adult courses. Finally, an attempt is made to meet the difficult job of obtaining the proper personnel by providing good facilities for academic improvement and opportunity for field work.

Constructing Large Models of Very Small Objects

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An exhibit in the recently opened Hall of North American Forests in The American Museum of Natural History portrays a six-cubic-inch section of forest soil, showing some of the many forms of life contained both within the soil and upon its surface and illustrates the relationship of this life in the cycle of the transformation of leaf litter into humus.

To present this story in a visible and dramatic way, the scale was enlarged twenty-four times life size (13,824 times in volume); an oak leaf, actually six inches in length, was enlarged to the impressive length of twelve feet, and a milliped three inches long was expanded to a six-foot monster!

A binocular microscope was used for studying the original specimens, which whenever possible were observed in the live state to determine form, color patterns, and movement. From this microscopic examination, it was decided what materials could best be used to simulate the form, texture, and color of the specimen for the large model.

For each of the following specimens a different technique was used. Although these descriptions are of specific models used in a particular exhibit, the methods employed or combinations of these techniques will find many applications in the museum display field.

I. ACORN BEETLE LARVA

This insect form, three-eighths of an inch long, when enlarged twenty-four times to nine inches, appears to be moist and shiny, with a wax-like translucency. Its spiny hairs are almost transparent. These characteristics suggested that a hollow wax casting would best meet the requirements.

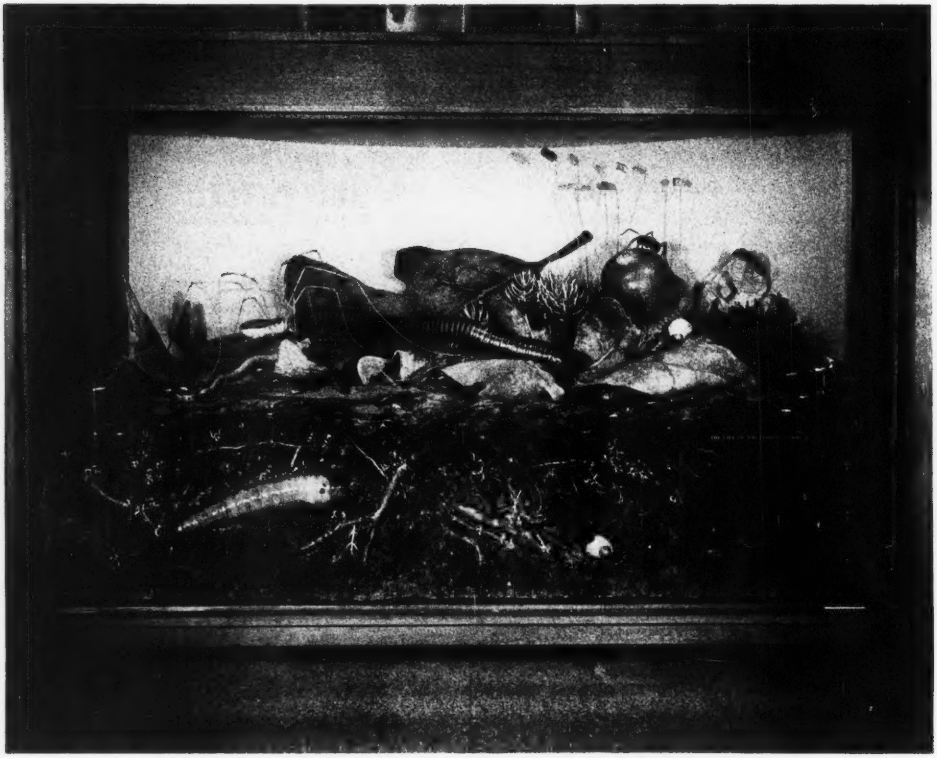


Fig. 1. Life of the forest floor exhibit in the new Hall of North American Forests in The American Museum of Natural History. The scale is twenty-four times life size.

Fig. 2

Fig. 3

Fig. 4

Technique

A. Modeling

Larva was modeled in Plasticine,[1] with the use of the notes, measurements, and visual observation of both alcohol-preserved and live specimens examined under microscope.

B. Mold

To obtain a mold from an object that has a surface containing undercuts, two methods are possible when several casts are required. One consists of using casting plaster and producing a piece mold, a complicated series of interlocking mold sections, which can be disassembled to release the cast. The second, and by far the easier method, which is described here, consists of making a mold of some flexible material that will stretch and compress so that the cast can be removed. Liquid latex can be used for this purpose, but this frequently requires the time-consuming process of building up a succession of several thin layers of rubber, before the mold is strong enough to be removed from the model. A material that affords the same flexibility but has the added advantage of being able to be poured and cured in thick sections is Cementex SP-8.[2] This material consists of a black viscous fluid that sets to a solid, rubber-like mass after an accelerator has been added.

1. Plasticine model of larva was coated with shellac and when dry given a thin coat of petroleum jelly. This acts as a separator for the Cementex.

2. After Cementex was thoroughly mixed with accelerator, the first coat was stippled on the model to prevent air bubbles from being trapped. The Cementex was then applied with a spatula to build up a thickness of one-half an inch.

3. The mold was cured by being heated for three hours at 150° F. (do not heat above this temperature or Plasticine will melt). Cementex can also be formulated to be cured at room temperature in 24 hours.

[1] Plasticine can be obtained in any art store.

[2] Cementex SP-8, produced by the Cementex Company, Inc., 336 Canal Street, New York 13, New York.

Fig. 2. Acorn beetle larva modeled in Plasticine.

Fig. 3. Cementex mold with Plasticine removed and showing plaster jacket.

Fig. 4. Completed model of the acorn beetle larva.

4. With Plasticine still inside mold, a plaster jacket was made to encompass the mold. This provides support to the mold during the casting process.

5. Plaster jacket was removed and Cementex mold cut open to remove Plasticine.

C. Casting

1. Hot wax was poured in open mold, half filling cavity.

2. Mold was quickly closed, and plaster jacket was secured in place.

3. Mold was rotated slowly but continuously until the wax had solidified. This process allows the hot wax to adhere evenly to the walls of the mold, which produces a hollow cast.

D. Completion

Wax cast was completed by affixing tapered nylon bristles to simulate hair, and coloring with oil paint. A final coat of copal varnish produced the desired shiny texture.

II. MILLIPED

The hard, horn-like quality of the body of this animal suggested that a technique of modeling directly in plaster and papier mâché[3] could be used. This method is especially applicable when a single model is required, because it eliminates the need for mold making and casting.

Technique

A. Manikin

1. A quarter-inch wire mesh was stapled to a supporting framework made of wooden discs centered on a steel rod.

2. Strips of burlap were dipped in plaster and draped over the manikin to cover the wire mesh completely.

B. Modeling

1. When plaster had set, a half-inch-thick coat of papier mâché was applied over the surface.

2. While the papier mâché was still plastic, it was modeled to the general form of the body, with delineation of the segments. This modeling was done with spatulas. Tool marks were smoothed out with a soft brush dampened in water.

3. When the papier mâché had completely dried, the final shaping was done with a wide variety of files and sandpaper.

C. Completion

1. A coat of shellac was applied as a sealer.

[3] Formula for papier mâché: four measures of dextrine; six measures of ground asbestos or paper pulp; seven measures of whiting; and seven measures of casting plaster. Mix dry to store, add water to use.

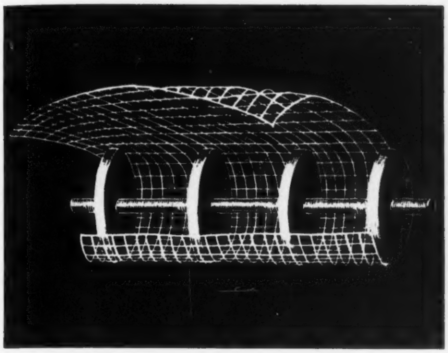


Fig. 5. Section of manikin for milliped.

Fig. 6. Model of milliped in preparation.

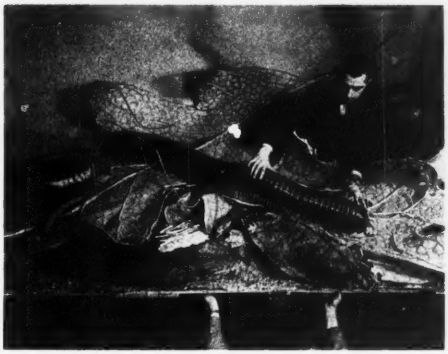


Fig. 7. Completed model of milliped.

Fig. 8. Completed daddy longlegs.

2. The model was colored with lacquer paint applied with an air brush.

3. A brown paste wax was applied and then polished with a brush to obtain the translucent, leathery appearance of the live animal.

4. Legs and antennae, which were cast separately, were finally attached to complete the model.

III. DADDY LONGLEGS

This animal, with its small, turret-eyed body suspended high above the ground from the eight stilt-like legs, presented a unique construction problem: the body of the model had to be light enough to be supported by the thin wire core of the legs.

Technique

A. Manikin

1. Body was carved from a block of balsa wood, with knives, chisels,

files, and sandpaper.

2. Balsa wood was next dipped in hot beeswax to acquire a texture simulating that of the animal.

B. Legs

1. Number 10 wire was wrapped with absorbent cotton conforming to the taper of the legs.

2. Hot beeswax was then brushed on cotton.

3. When the wax had set, the legs were smoothed with finishing-grade sandpaper moistened with turpentine.

4. Joints and segments were cut into wax and smoothed, as described above, with sandpaper.

5. A thin glaze of oil paint was brushed on legs to reproduce color.

6. Number 34 black iron wire was used to duplicate the hair on the legs. This wire was stretched to straighten and harden it. Short pieces were then fastened by being pushed into the wax.

C. Completion

Legs were assembled to balsa wood body by being inserted into holes drilled for this purpose. Finally model was painted with oil paint stippled on with a brush.

IV. LAND SNAIL

The thin, semitransparent, pearly shell of this animal indicated that the large model could be formed from cellulose acetate.

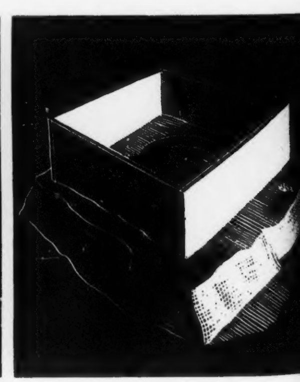
Technique

A. Modeling

1. Shell was modeled in Plasticine.

Fig. 9

Fig. 10



B. Mold

1. Plasticine model was set, up to one-half of its depth, in water clay.
2. A dam was made to surround the model and its clay bed completely.
3. Plaster mixed to a creamy consistency was poured within dam to a depth of one inch above the exposed portion of the model.
4. When plaster had set hard, the dam was removed, and the cast was turned over, exposing the water clay. This was then carefully removed to expose the top half of the Plasticine model.
5. Keys were cut in plaster section to insure the proper alignment of mold pieces.
6. Light coat of petroleum jelly was brushed on plaster to act as separator.
7. The section of mold with its exposed half of the Plasticine model was enclosed with a dam, and plaster poured, as described above.

Fig. 9. Shell of land snail modeled in Plasticine.

Fig. 10. Plasticine model of snail shell set in clay and surrounded with a dam in preparation for the pouring of plaster.

Fig. 11. Plaster cast of upper mold section, keyed and with Plasticine model of lower half of snail shell exposed.

Fig. 12. Dam in position, ready for the pouring of plaster for lower mold section.

Fig. 13. Completed model of land snail.

11

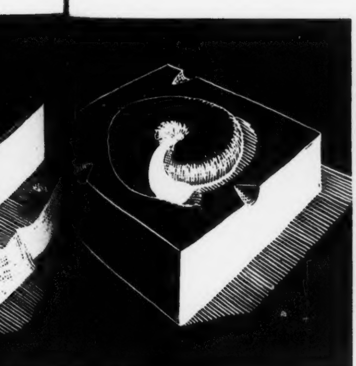


Fig. 12

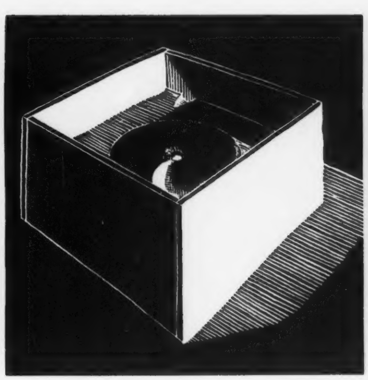


Fig. 13

8. When plaster had set, the resulting two-piece mold came apart easily for removal of the Plasticine model.

9. A male section was made for both mold halves by compressing Plasticine into the plaster molds.

C. Cellulose Acetate Impression

1. Sheet of cellulose acetate (0.0100 thickness) was immersed in a bath containing one-half acetone and one-half water, until it had become pliant.

2. The relaxed sheet was then placed in the lower mold and carefully pressed into place with a cotton swab moistened in acetone solution.

3. The Plasticine male section of the mold was quickly put in place, and the assembly was held within a slight but uniform pressure until the acetate was rigid. A hydraulic press or even a letterpress can be used for this purpose.

4. The above process was repeated in the upper section of mold to procure its impression.

5. The surplus acetate was then trimmed off with scissors.

D. Painting

1. The inner surface of both shell sections was then painted with transparent lacquer color applied with an air brush.

E. Body of Snail

The body of the snail, although to be shown entirely within the shell, was to be partly discernible through the transparent surface.

1. Body was modeled in Duron (vinyl dough),[4] a thermo-setting plastic, capable of being shaped like Plasticine, but with the added advantage of being cured to a firm, rubber-like solid when heated. The model of the body was made to fit accurately within the two halves of the plaster mold, which insured a perfect fit when the model was enclosed within the cellulose acetate impressions of the shell.

2. Vinyl dough model of body was cured in oven for one hour at 350° F.

F. Assembly

1. Upper and lower sections of acetate shell were cemented together, enclosing the vinyl dough body of the snail. Methyline chloride was used as a cement.

2. The final pearly effect was obtained by application of pearl essence lacquer to the external shell surface in a thin glaze.

V. OAK LEAF

The microscopic examination of an oak leaf disclosed the intricate webbing that supports the cellular tissue. The model of the leaf was re-

[4] Duron (vinyl dough), obtainable from Sculpture House, 304 West 42nd Street, New York 36, New York.

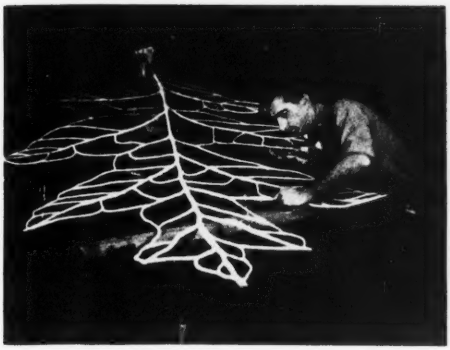


Fig. 14. Construction of leaf framework.

Fig. 15. Enlarged oak leaf in preparation.

quired to depict this structure and also to retain the translucent quality of the fleshy leaf. In addition the leaf sections were to be shown in various stages of decomposition and form. The following method was devised to meet the specialized requirements.

Technique

A. Leaf Print

1. Printers ink was applied to the back of the leaf specimen with a roller.

2. Inked leaf was placed wet side down on a sheet of paper.

3. Clean roller was run over leaf to produce a print.

B. Enlarged Leaf Pattern

1. Half-inch squares were lined over six-inch-long leaf print.

2. One-foot squares were lined on pattern twelve feet long.

3. Drawing enlarged twenty-four times was obtained by copying in the enlarged squares the outline and veining shown on the corresponding squares in the print.

C. Framework for Leaf

1. Steel rod one-half inch in diameter was used for main stem.

2. One-quarter-inch rod was spot-welded to form main branches.

3. One-eighth-inch rod was soldered to form smaller branching.

D. Forming

1. Absorbent cotton was wrapped around rods to conform to the proper thickness and taper.

2. Hot beeswax was brushed on cotton and allowed to set hard.

E. Mold

1. A two-inch thickness of water clay was laid on a table, and the assembled leaf framework was embedded in it, so that two-thirds of

its height was exposed above the clay.

2. The finest leaf webbing was then pressed into place on the clay. This webbing was made from five-ply Imperial Cord one-eighth of an inch in diameter. The cord was dipped in melted beeswax, then, having cooled, was bent and cut to fit. The cells of the epidermis, half round in shape, were impressed on the clay with a tool made from a dowel with a rounded end.

F. Cast

1. Sheets of absorbent cotton were placed over mold, lapping to cover entire framework.

2. Melted beeswax was poured and brushed over the surface of the leaf, proceeding from one end to the other. The cotton, when saturated with wax, conformed easily to the mold surface and formed a close bond with the cotton and wax-covered framework and veining.

G. Shaping

1. When wax had hardened, the leaf cast was lifted entire from the clay mold.

2. Heat lamps were applied to soften the wax enough so that the wire framework could be bent to the required leaf shape without cracking the wax.

H. Painting

1. Leaf was painted with oil colors in transparent glazes to retain the maximum translucency.

Should Museums Try TV?

WILLIAM A. BURNS, ASSISTANT TO THE DIRECTOR
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TRUSTEE, THE METROPOLITAN EDUCATIONAL TELEVISION ASSOCIATION

Although this paper deals specifically with the problems involved in producing television programs for a museum of natural history, the basic philosophy is just as applicable to art, history, health, industrial, or general museums.

There are two kinds of television—commercial and educational. There are two ways of presenting museum material on television—the sugar-coated method and the straight teaching program. Let's look at each of them.

Commercial television depends on a large and heterogeneous audience. Because the producer or the advertiser must reach the greatest number of people, he plans his programs with an eye to satisfying everybody. Because public taste is still not necessarily of the highest order and sustained interest is hard to come by, the programs are limned in raw primary colors, and the more delicate pastel nuances are left to experimenters who aim their product at what they call "cultured audience appeal." The ratings of the latter are thus far proverbially low.

Educational television is a separate entity. It assumes that the motivation to view the program exists when the viewer turns on his set. Educational television teaches or it is not educational. And it is entirely fallacious to believe that television is an entertainment medium and that educational programs must always be entertaining to hold an audience. In itself, television is a medium of communication, as is a book, a magazine, a newspaper, or the radio, and entertainment is no more inherent in it than it is in a blank sheet of paper in a typewriter. It is what you put on the paper that makes it entertaining, educational, amusing, or boring.

There are, as we noted, at least two ways of presenting museum ma-

terial on television. The sugar-coated way is to introduce attention-catching "gimmicks," extraneous window-dressing, and to instruct your guest or expert to observe either the Stanislavsky technique or the Actor's Studio method. This, for educational television, is both time-consuming and time-wasting. It does not mean, however, that a museum television program should be dull. Good education is never stuffy or boring. But if your viewer tunes in just to be entertained, he will more than likely switch to a quiz show instead. And if he does, you have not failed. He simply bought what he wanted at the moment.

You might as well make up your mind that museum programs will always have a limited audience in contrast to spectaculars, especially when presented over an educational television outlet. If you have been invited to take over an empty time slot or "island" on a network, then you may be sure that your offering will be re-worked, re-written, "souped-up," "gimmicked," and gadgetted until it meets the commercial standards of mass audience appeal. Unless the program is unsponsored, you can count on educational time's being lost to commercials, and you can write off educationally the minutes spent in "sweetening up" the subject because the network people think it will otherwise be unpalatable to their viewers.

Television—present-day two-dimensional television in black and white or in color—is probably the most effective and powerful medium of communication yet devised by man. The future may hold tri-dimensional color TV, where the illusion of roundness, color, and depth is perfect. But until that comes along, we have never had a better way to appeal to large masses of people. Granted that Mark Hopkins at one end of a log and you at the other makes a university. But put Mark Hopkins in a TV studio and you have perhaps a hundred million people sitting on the other end of the log.

Now what has this to do with television in museums, particularly museums of natural history? Such institutions have as one of their objectives the telling of the story of the universe, the earth, and its inhabitants, together with their total relation to one another. We know that man is a part of nature, although he controls much on earth. But he is still subject to great basic laws and forces that restrict and restrain him within marked boundaries. Throughout the ages, and especially since the invention of power tools, he has created difficulties for himself through a lack of understanding of the consequences of his own acts. He has plowed the plains and reaped the dust bowl. He has cut down and burned his forests and flooded the land on which he dwells. He has mined the soil, wasted water, and used up irreplaceable resources on which his future may depend.

Our task is to re-acquaint each generation of man with his environment —to show him that it means as much to the city man if southern fields are overcropped as it does to the Georgian cotton farmer; that western forests,

laid waste, are as important to the New Yorker or the Chicagoan as they are to the man from Oregon. All share equally in the result and its effect on national economy.

Television has widened our audience so that we can talk to hundreds of millions of our people in the peace and quiet of their living rooms. It gives us a wonderful opportunity to carry our message of survival to a significantly greater percentage of our people.

But the natural history television program cannot float on air like Mahomet's coffin. It must be tied to man and his activities. It must show him that he is a part of nature, that he is influenced by nature and influences it in turn. The exotic approach to natural history has done more harm to the development of museums and their work than has lack of money. Too many people still think of museums as places where the bizarre, the mysterious, the largest, the smallest, the quaint, the cute, the terrible, and the farthest away are kept on display for their collective amusement, entertainment, wonder, or ridicule. Because museums *were* like that not too many years ago, people tend to look for such exhibits in today's museums, and go home after their visit with a feeling that natural history is interesting but it does not apply to them individually and personally. We must, then, stress the personal relationship and foster a feeling of individual responsibility, whether it be through our hall teaching or on radio or television. Programs must serve the best interests of our population and stimulate in them the need and desire to form their own opinions, establish their own convictions, and take whatever action is appropriate, whether it be more thought on the subject or a letter to their congressman.

The American Museum dove into the shark-infested waters of commercial television with its "Adventure" show on the Columbia Broadcasting System network on May 10, 1953. The final show was telecast on July 8, 1956. During those three years and three months we learned a lot about writing, producing, and directing a natural history series over a great network.

We approached the project with some misgivings. Our scientists, who were frequent guests on the shows, feared that the scientific message would be downgraded in favor of sensationalism in order to gain the widest possible audience. The CBS people, who occupied a suite of offices in the Museum, worried about the fancied difficulties they might encounter in persuading a noted biologist or anthropologist to "do something" with an object in order to get life and motion into the program. As we were later gratefully informed by the television people, television writers and directors began to become concerned about the right scientific emphasis and accuracy, and some of our scientists wondered if they were going to be given the best camera angles at broadcast time!

During the thirty-nine months of cooperation with CBS, we became

aware of the fact that the best shows we produced came out of our own institution and collections and with our own staff. (On occasion, material and personnel from outside the Museum were used on programs.) We also found out that some scientists do not take kindly to public appearances, particularly when they suddenly realize that millions of people are looking at them. We discovered that programs with continuity—for example, a series on evolution or a series on paleontology—went best with our audience, judging from the fan mail.

We also found out that there is still a conflict between pure educational presentation and the commercial program, although we had no sponsor to cater to. Producers and directors on commercial stations worry about ratings even without an agency on their trail, and their shot-in-the-arm for a low audience index harks right back to the old-fashioned museum with its bizarre, its mysterious, its largest, and its smallest. This is what we have been trying to avoid, and it leads us to only one conclusion—that, as long as commercial television feels the need for larger audiences than its competitor enjoys, museums must either bow to this necessity or turn to the channels of educational television.

Educational television is in its infancy, but it is a lusty offspring of a sometimes weary and bedraggled parent. In fact, there are, at this writing, thirty educational television stations operating in the nation. These are organized under three plans—the single agency, where the university or college or school board is the licensee; the state-wide network plan, in which a state educational agency or educational TV authority is the licensee and the money comes from state funds; and the community station plan, where funds come from the local community, and the work is organized by the cultural institutions in the community.

Regardless of the plans of the educational stations, they gravitate naturally to museums for programs, and it may be that our greatest impact will be made by means of educational TV. But first let's look at some of their special problems.

First, the budget of the average educational TV station is limited. It cannot afford large and elaborate programs nor does it particularly want them. But it does require basic scenery to suit individual programs, and it needs scripts that are professional in quality. The educational TV producer realizes more than do the museums that you cannot shove an expert in front of a camera and expect him to do a good job without preparation.

This means, in many instances, that the museum is asked to pay for any out-of-pocket expenses for scenery, special construction, script writing, and film clips for use on the program. The station provides the usual facilities—camera, lighting, direction. But even with the above-mentioned expenses, museums need not lay out thousands of dollars for a TV program. Some institutions are lucky enough to have on their payrolls talent

that can turn out acceptable scripts. If not, the station can recommend script writers who understand the problem and can cooperate with the expert in preparing the script. This is usually done without too much loss of epidermis by either party. Museums usually have a small truck that can be called into service for transportation of materials, since most educational TV programs are done in the studio because of the high cost of remote telecasting. This is sometimes unfortunate, since many museum exhibits cannot be removed and have to be used *in situ.*

The museum and its staff must familiarize themselves with television techniques. They are not difficult to learn, but are necessary for a good presentation. The greatest scientist or art expert in the world may draw a large initial audience, but if he weaves back and forth or continually puts on and takes off his glasses or mumbles his lines into his beard instead of at the mike boom, his viewers will snap the dial to Arthur Godfrey.

About the programs themselves: Because museums are educational institutions, they must present educational programs, with entertainment a secondary goal. They must make the most effective use of the medium which is televisicn. There are various ways to accomplish these desirable ends.

Let's take a wholly imaginative program theoretically produced by the American Museum and telecast in the educational TV studio. The agreed-upon theme is the importance of soil conservation through the careful use of our forests. Now, we could get an expert on conservation and have him do a thoroughly dull and tedious job on forests in the United States, complete and replete with wall maps, graphs, dendrograms, and a new pointer with a rubber tip.

We don't want to do it that way, so we ask the scientist to hold up a piece of pine shelving and say, "This piece of pine cost 35¢ in 1935. Today it would cost you $1.05. Why?"—and then go on to explain. Then he holds up a loaf of bread and tells why it costs more now than it did in 1920, and why farmers are being forced to move from their land because of dust and erosion.

To show how the indiscriminate cutting of forests helps to wash away irreplaceable topsoil, the museum's exhibition department has made a lipped inclined plane, with half the area covered with soil alone and the other half with soil supporting moss and living plants. The scientist sprinkles water from a watering can equally on both sides of the inclined plane and the runoff is collected from each side in bottles. The amount of topsoil in each bottle is compared, and the scientist demonstrates far better than by words or still pictures the need for keeping our natural cover where possible, so that driving rain and natural runoff do not deplete our soil bank, on which we depend for our vegetable and meat diet.

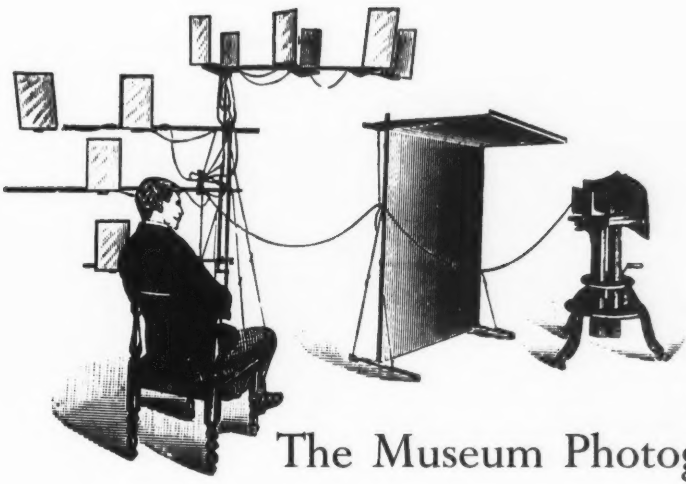
Such a demonstration, in company with other demonstrations that fit in with the visual appeal of TV, plus the personality of the scientist, makes for good educational TV programming from a museum. The question has been raised as to whether it would be better to hire an actor to play a scientist's part. Stomach ache commercials should answer that one. Nobody believes for one moment that the man in the white coat, who is burning holes in cambric handkerchiefs with strong acid, is anything more than a hired salesman, and the almost subliminal flash—"A Dramatization" —is an insult to one's intelligence! The actual expert carries with him an air of authenticity, sometimes accentuated by his very lack of slickness before the camera. But he ought to be restrained from putting on and taking off his glasses.

So let's stick to the anthropologist talking about anthropology and the art expert discussing Van Gogh. Let's leave the actors to Heaven and Heaven knows we can't afford them anyway.

We've talked about commercial and educational television and the aims of each in presenting their programs. We have touched on the philosophy of museums with reference to the need for television programs emanating from their institutions. We have been specific as regards the museum's approach to personnel and programming and the relative merits of educational television over commercial outlets.

What it all boils down to is this—that we, as representing museums of *all* categories, have the obligation to bring our respective messages to as many people as we can. We are a free society with free individuals who must make up their own minds, form their own opinions, and then resort to intelligent thought or action in connection with everything that concerns the future of our nation—and that includes art, natural history, history, health, industry, and all the many-faceted aspects of our national life.

We must give them the best we have—materials, experts, and ideas—so that when the picture fades the viewers will be left with something of value.



LEE BOLTIN

The Museum Photographer

The unanswerable question of where mankind stands today in terms of accurate knowledge of his past takes on a new fascination when reviewed against our ability to document our activities accurately through the remarkable medium of photography. Today there is little that cannot be and, indeed, has not been recorded through the various photographic systems. Much greater developments in the field are yet to come. The museum, whatever its particular area of concern may be, must be a primary user of this unique method of recording the past and the present for the future.

Before we can examine the "how-to" of the museum photograph, we must first consider the principal function of the photographer's art. The prime ingredient for the museum photographer is unflagging curiosity—a persistence of vision, so to speak. If he accepts the definition that the work of the museum is to educate, to accumulate, and then to reveal concomitantly, his standards must be unflaggingly high, and he must operate on this basis and this basis alone. His curiosity—call it research, constant application, hard work—must insist on the application of *self* to the problem at hand, both philosophically and practically, rather than solely on the dependence upon and the use of the mechanical tools of the trade. He must search for the experience of highest artistic interpretation, based on a very solid technical foundation. By definition, this cannot be a casual approach. Nor can it condone an easily satisfied appetite. As in any endeavor, the goal must be diligently pursued with constant technical research, experiment, reading of literature. To modify this can only lead to the most mundane and even meaningless photographic

exercises, which will be marked as largely pointless by historians of the future.

If the photographer, through his own limitations, cannot bring himself to this interpretation of his work, the inevitable result will be production of a most pedestrian nature, and with it a built-in factor of short-changing the museum, the public, and, regrettably, himself. For within the context that photography is or can be a creative art, depending solely on the man at the camera, it is of critical importance that the photographer examine himself and his discipline no less than any other responsible curator.

It is here that those who merely use cameras are sharply separated from the fine creative photographer who follows the disciplines of his profession. For the entire process of museum photography (or, indeed, any other kind) is essentially not complicated.

At the present stage of photography, many of the day-to-day problems of the museum photographer are fully explained in the readily available literature. This covers a wide area of activity from X-ray through photomicrographs, publicity pictures, and nearly everything in between. New materials are available, and more are on the way, including long-latitude films, new systems of color, instantaneous gaseous discharge lamps, sodium vapor lamps, high resolution films, and films sensitive to spectrum areas and illumination levels never before possible.

There is little that cannot be accomplished in standard museum picture problems with the proper use of a 35-mm. camera of the quality and design of the Nikon or its ideal companion instrument, a single- or twin-reflex camera, such as a Rolleiflex or Hasselblad. I do not mean to minimize the value of specialized cameras for particular jobs. However, the Nikon, the Rolleiflex, or a similar camera can fill the needs of most institutions if it is in the hands of an imaginative photographer. However, at a certain point, mechanical means become static, and it is here that the photographer becomes the functioning instrument.

The files of every institution are overloaded with the products of unthinking picture-making. Many lack meaningful interpretive techniques. Others are simply "post-card" pictures. Yet, the museum photographer is a custodian, not only of his own museum, but also, and of equal importance, of his own time and society. For the vast percentage of the populace, both in and out of museums, exposure to new ideas occurs first through graphic demonstration which, overwhelmingly in our time, is the photograph.

Museum photography, with its many ramifications in scientific documentation, artistic interpretation, publications, and the always vital area of public relations, has moved out of the area of catch-as-catch-can. Now, in order to utilize the endless possibilities presented to it, it demands a

discipline of its own. Regrettably, only in comparatively rare circumstances does this situation obtain. It is up to the individual photographer to realize that he is very often the total expression of the museum for the thousands who can never come to the institution. In that sense, he must perform consistently with the highest possible imagination, intelligence, and integrity. If he falls short in this, he degrades the work of all those who have gone before in research, design, and exhibition.

Dry Preservation of Biologic Specimens by Plastic Infiltration

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Below is a description of the infiltration of fixed biologic specimens with Methacrylate plastic. This method of dry preservation is best applicable to specimens that are not suitable for embedment, such as large biological specimens, whole brains, and hollow organs, e.g., the entire human digestive tract. Good results have also been achieved by this method with small specimens, such as reptiles, amphibians, and fishes, which are too difficult to be mounted by standard taxidermy methods. We have also infiltrated such objects as reed baskets and mummified hands which, owing to age, have become extremely brittle so that they crumble when handled. After infiltration specimens regain their flexibility, become less brittle, and further deterioration of the specimens stops. This method is at present in use at The American Museum of Natural History, and is a modification of the method previously described by one of the authors (Sills).[1]

Technique

A. Fixation

1. The specimen is set into position and thoroughly fixed. Any fixing solution can be employed, but we prefer formol-alcohol.

[1] Sills, Bernard, *New Technique for the Preservation of Pathological Specimens in a Dry State*, Quart Bull. Sea View Hospital, V. 11, 1950, P. 159; *Use of the Polyethylene Glycol in Dry Preservation of Anatomic and Pathological Specimens*, Lab. Invest., V. 1, #3, 1952.

B. Dehydration

1. Remove specimen from fixative, let drain thoroughly, place directly into a Carbowax[2] bath, and cover.

2. The average specimen is kept in Carbowax for at least two weeks; longer periods may be necessary for larger specimens, e.g., liver, brain, and stomach.

3. Two or three changes of the glycol will insure complete dehydration.

C. Removal of Carbowax

1. Before the specimen is to be processed further, place the dehydrating specimen in an oven set at 50° C. for one week.

2. Remove specimen from bath, let excess wax drain, then blot, and gently press to remove as much Carbowax as possible.

3. Suspend specimen in oven set at 90° C. for one hour. Place pan under specimen to catch drippings.

4. Remove specimen and put in xylene bath.

5. Allow the specimen to remain in xylene for from three to ten days.

D. Infiltration with Methacrylate Polymer

1. Dissolve enough Lucite P-44[3] in xylene to give a solution with the

[2] Carbowax #600 (Polyethylene Glycol #600), product of Carbide and Carbon Chemicals Company, New York City.

[3] Lucite P-44 n-Butyl Methacrylate Polymers, E. I. Du Pont de Nemours and Company, Wilmington 98, Delaware.

Fig. 1. Specimen in cooker.

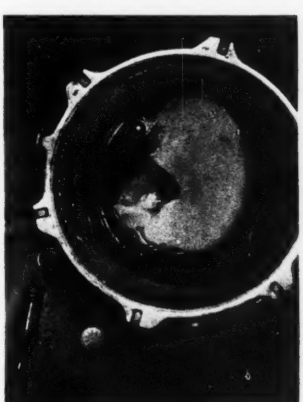


Fig. 2. Specimen in oven.

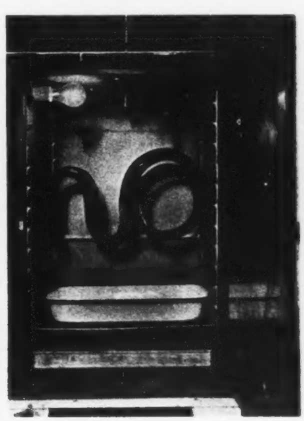


Fig. 3. Supporting frame.

viscosity of mineral oil. Transfer specimen from xylene to plastic bath.

2. Infiltrate specimen for at least two weeks, using alternating positive and negative pressures.

E. Construction of Supporting Frame for Coating Specimen

1. The specimen, after removal from the plastic bath, must be suspended in such a fashion that its position can be readily changed and all surfaces are easily accessible. We have achieved this by the construction of a simple wooden frame, in the sides of which many small holes have been drilled. The frame is constructed larger than the specimen which is suspended in the center of the frame by means of large rods, pins, or ties, or by whatever method will insure proper support.

F. Coating the Specimen

1. Remove the specimen from the plastic bath and suspend it in the frame.

2. Allow the excess plastic to drip off.

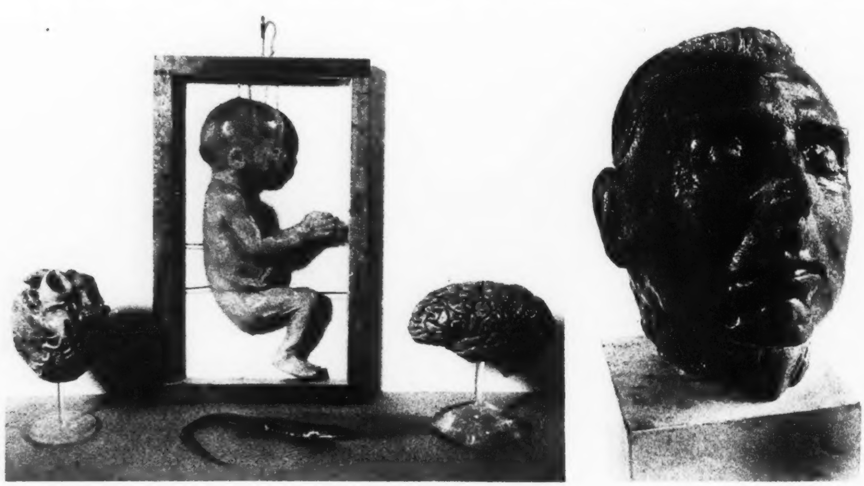
3. Coat with plastic spray[4] every half hour.

4. After the first day spray specimen every two hours.

5. When a smooth, even coat has been obtained, allow the specimen to dry thoroughly for about two weeks before handling.

[4] Plastic spray manufactured by Krylon, Inc., Norristown, Pennsylvania.

Figs. 4 and 5. Completed infiltrations of heart, fetus, lizard, human brain, and a whole head.



Comments and Discussion

1. We generally use formol-alcohol as our fixing fluid in the proportion of one part of 40 per cent formaldehyde to nine parts of 95 per cent alcohol. Prior to use it is diluted with an equal volume of water.

2. Carbowax is a synthetic water-soluble wax, and because it is hygroscopic, it provides dehydration. For the same reason the bath should be covered.

3. Minimum time for specimens in Carbowax is two weeks; however, longer periods for larger specimens may be necessary. Any specimen can remain in the bath for an indefinite period of time without deterioration.

4. It is necessary to change the Carbowax bath one or more times in order to remove all traces of water present in the tissues.

5. Heating the Carbowax infiltrated specimen at approximately 90° C. for one hour reduces the viscosity of the Carbowax and thus facilitates its removal from the specimen. This also drives off any traces of moisture picked up by the Carbowax during the initial processing of the specimen.

6. The xylene bath helps dissolve out any Carbowax still remaining in the specimen and facilitates the penetration of the plastic.

7. Changing the xylene bath prevents contamination of the plastic with the Carbowax.

8. When a pressure cooker is used as a container in the various steps of the processing of the specimen, we employ positive and negative pressures in order to facilitate penetration of the solutions.

9. Initial penetration of the plastic is helped if the viscosity of the bath is like that of mineral oil. Over a period of time and with constant positive and negative pressure changes, the plastic bath will thicken owing to evaporation of the xylene.

10. If the specimen is mounted in a frame in the desired position, the unit can be rotated so that one has access to all surfaces without handling.

11. By continuous spraying with Krylon plastic, one forms a thin, even, protective coat over the entire specimen.

12. Those areas that are not well penetrated, where the surface coat is lacking, or where air is trapped between the layers of tissue, will appear white and opaque. These areas are resoftened by being wet with xylene and then recoated.

13. If many such areas appear, replace in plastic bath for an additional period of time.

14. The plastic infiltrated specimen upon drying develops a high gloss; if this condition is not desirable, dab on a thin coat of paste wax, allow to dry, but *do not rub*.

15. The color in most organic specimens upon infiltration will fade. This condition can be remedied by retouching or tinting with colors.

Exhibits — Firing Platforms for the Imagination

KATHARINE BENEKER
ASSISTANT AND IN CHARGE OF TEMPORARY EXHIBITS
OFFICE OF EXHIBITION AND CONSTRUCTION
THE AMERICAN MUSEUM OF NATURAL HISTORY

I hesitate to talk to you about children's exhibits because it seems presumptuous of me, who has never designed such an exhibit, to speak to a roomful of people so experienced in that work. However, I feel that I may have something to share with you in spite of the fact that I do not believe in exhibitions just for children.

I say this for several reasons. One is that children are much better informed than we think they are—in fact, better than many adults. Their intuition is sharper, their imaginations are keener, and their comprehension is greater, because they have not so many preconceived ideas and have not been exposed for so long a period to misinformation.

The second reason is that each individual, no matter of what age, approaches an exhibit, or a book, or a picture, or an idea in terms of his own understanding and experience. For instance, if a shoemaker, a housewife, and a small boy visit an exhibition on Indians, the shoemaker will be especially interested in the moccasins, the housewife in the embroidery and cooking utensils, and the small boy in bows and arrows and in canoes. There is a good chance that, if they compare notes later, the shoemaker will not have seen the cooking utensils and the housewife will not remember the canoes.

The third reason is that children need room in which to grow. Children are explorers and dreamers. That is part of being a child. They are

(EDITOR'S NOTE: Miss Beneker delivered this speech in May 1958 before the Children's Museums Section of The American Association of Museums.)

curious about the world in which they find themselves. To reach, to stretch, to question are part of this process of growing, and, if an exhibition is arranged to fit what we adults think is a child's level of understanding, it will probably be a statement of what he already knows and will leave no room for exploration or for the exhilarating experience of discovery for himself. I recently took several children to an art museum, and on the way to what I thought might be an interesting exhibit for them to see, we passed through a gallery of paintings by Bierstadt, Coles, and Kensett—a school of painting that I did not think would appeal to children, so we were hurrying along. But the children wanted to stop and look. Every picture was examined in detail, discussed, compared, reëxamined, and questioned—in other words, discovered, explored, and consequently remembered. And we never reached the exhibit that I thought would be fitting.

To be sure, there are many kinds of exhibitions. Some of them are for college students, some for scientists, and some for specialists. But the exhibits for the greatest number of people, those who have no specialized knowledge, are the ones with which we are here most concerned. These are the exhibits to stimulate thought and interest, to send the viewer, regardless of his age, on the way to greater knowledge and to greater understanding.

To me an exhibit is a springboard, although I suppose that in this day and age a better comparison would be a satellite-carrying rocket. The rocket gets the satellite off the ground and hurls it into that vast unexplored area, outer space. An exhibit gets the visitor "off the ground" and into an area that is still unknown to him. In both cases, there must be a firing platform, and that, in an exhibition, is the familiar, whether it be an object or an idea. From this platform, you, the exhibitor, can fire the imagination and carry it out into other areas of knowledge, or (and this happens all too often) your exhibit can fizzle and never get the visitor off the ground.

What is meant by "the familiar" and how can it be used? Let me give you an example. If, at the height of the craze for Davy Crockett hats, you had placed one on exhibit, you would have caught the attention of every man and boy and harassed mother in America. This would have been a firing platform that could lead to history, to art, to natural science, to social studies, to exploration. If natural science: What kind of fur is it? What does the animal look like? Where does it live and what are its habits? How is it trapped, how skinned, and how made into clothing? And what happens to the balance of nature when man starts trapping? If history: Who was Davy Crockett? Where and when did he live? Why did he wear such a cap? Who were the early settlers and where did they live? What effect did these people have on the development of

this country? And art: A well-known museum in the east seized the opportunity to borrow a portrait of Davy Crockett to put on exhibit, and thousands of people, who might never have entered an art museum, came to see what Davy Crockett looked like. This museum could have gone a step farther and used the portrait as a firing platform for an exhibition on the artist John Neagle and his contemporaries. But this, as simple as it was, was using a familiar object to introduce painting to a new audience.

One of the primary considerations in the choice of a platform on which to build an exhibition is to know one's community—whether district, town, or city. What kind of people live there? Is it an insurance town, such as Hartford, a cattle town, such as Cheyenne, a steel town, such as Cleveland?

I know of a museum in a steel factory which is wasting a great potential. It has all the ingredients for a meaningful exhibition, but the steel worker, or the casual visitor, must dig into dark corners in order to find the one thing that has meaning for him. Where does that piece of steel that he turns out day after day fit into the finished rocket, or machine, or instrument? Why is it important that he do a perfect job? What he makes may be a far cry from the crude, hand-wrought tools of the Iron Age, some three thousand years ago, but there is a direct and steady connection. The steel worker has a long heritage. Yet can he tell you when it started or what effect the use of iron has had on the development of our present civilization? Or even what iron is? Has he ever seen a mine? Does he know what the other elements are? Does he know what an element is? The potentials for firing his imagination into thinking of himself in a new light are tremendous, and as a result of this new knowledge and new thought, he will acquire a pride in his work and a feeling that he belongs to something bigger than the company.

We are museum workers, yes, but we live in a world of people, not in an ivory tower. We are too prone to bask in the prestige of the word "museum" and forget that we are part of, and responsible to, a life outside our walls. You may not have a museum in a factory, but you do have one in a community of people. Is a large percentage of its inhabitants Swedish, or German, or Hungarian? In New York we have a growing population of Puerto Ricans, but not one of us has put on an exhibition that would show the contribution, or background, or both of these new citizens. We expect them to learn about New Yorkers, and learn fast, but is there any attempt on the part of museums to help us understand them? What have these people contributed to our culture? How are they similar, how different? What are their characteristics, and what kind of life did they lead before they came north? Probably the Puerto Ricans have never stopped to ask themselves these questions, nor have we. Yet

an exhibition could and would produce greater understanding on our part and greater self-respect on theirs.

Once you have decided whom you are trying to reach and have selected the idea for an exhibition and the means of getting the viewer off the ground, how do you make the exhibit? The same principles of good exhibition apply to all exhibits, whether you consider them for adults or for children. These are simplicity, clarity, and accurate interpretation. I cannot tell you the best way to design an exhibition, because there is no best way so long as you include these three requisites. The worst way is to ignore them. What the designer produces is largely a matter of personal taste. I like red, but perhaps you cannot stand red. I think there should be more light on the object, and you think there should be less. I want a case here, and you want one there. These are all matters of taste, and taste cannot be argued. However, there are a few basic tools, such as knowledge of line, form, composition, color, and lighting, and there are many materials and textures that are available for little or nothing if we keep our imaginations open to their possibilities. For example, one of the most common and least expensive is corrugated board which can be cut, shaped, and painted to form a background. There are other materials, too: metal lath, screening, matting, burlap, sawdust, metal shavings, wood curls, coal, gravel, cork, and just plain sand.

But the one important thing to remember is that the objects and the story are more important than any of the techniques you use and that these techniques must never detract from, but always advance, the purpose of your exhibit. In other words, the background, the color, the labels, and the juxtaposition of objects must all work together to clarify the point.

When we museum workers go on a busman's holiday, we look for new ideas and methods and therefore are overly conscious of details. We notice the color, the way the labels are printed, the kinds of cases, and the lighting. But the child or adult does not see these things. He has come to the museum to see objects. He is unaware of the old, made-over china cabinet or the expensive bronze case. It is the material inside that interests him. In fact, he probably will not be able to tell you the color of the background, unless it is so prominent that it completely overshadows the contents, or whether the labels are printed or hand-lettered unless he cannot read them.

There is much talk about standards, but I do not feel that we can establish standards of display, because such standards change with each generation and with each turn of fashion. Our predecessors firmly believed that they were using the latest and most modern display methods when they installed what to us appear to be antiquated exhibits. Today

we feel that ours also are the last word. Yet tomorrow or a decade hence, these same exhibits will be just as obsolete. Therefore, let our standards be in the field of content—simply, clearly, and accurately defined—and in the richness of our imagination.

Money is not the answer, because money is too often used as a substitute for qualities that are far more important—ingenuity, enthusiasm, understanding, and the conviction of an idea. If you or your personnel do not have these qualities, look to your community and take advantage of the people who are bursting to tell you how to run your museum.

For years I have heard that museums are poverty-stricken, but I am inclined to believe that we are stricken with poverty of the mind as well, and this is a more serious drawback than lack of money. An exhibition is a means of communication, and, if we have nothing to say, neither will the exhibit. Too often our lives are confined to four museum walls—fireproof, mothproof, rainproof, and thought-proof. We have not taken the time to broaden our base of understanding by getting out among people to find out how others are thinking, eating, laughing, loving, and hating. Try going to a stock-car race, a "greasy spoon," a burlesque show, a rodeo, a revival meeting, an opera, or a ballet, and talk to the people there. By enlarging our experience in all directions, we will bring a freshness and richness to our thinking if not to our pocket books.

Speaking of empty pockets—there are exhibits to be had for the asking, but do not take the easy way and install a telephone exhibit just because you can get it for nothing, or a model train because it is a present, even with no strings and a maintenance fund attached! These are space fillers and have no place in a museum unless they are used as firing platforms. Both of them are "naturals." There is nothing more familiar to present-day Americans than the telephone, and it is a quick step to the subject of communication. If you are a natural history museum, how do animals "communicate" and why? The rabbit thumps his hind leg in times of danger. He may not intend it as a warning, but other rabbits know that something is wrong. The crows seem to have a system of warning their friends in the corn field. Foraging bees return to the hive and indicate by a "round dance" or a "waggle dance" where the nectar is located. How has man from the beginning of time communicated with his neighbors? What about Africa's talking drums and the Indian's smoke signals? If you are an art museum, how has man, from cave days to the present, told others how he thinks and feels, through drawing, painting, and sculpture, on rocks, on walls, on paper, on canvas? The same thinking can be applied to transportation, and the model train becomes not a novelty and a toy but a meaningful part of a whole.

All exhibits should be educational, of course, but, more than that, they should enrich and enlarge the life of the person, child or adult, who sees

them. Their value lies not within the museum walls but in how much the visitor takes with him when he leaves. If you have started him on a new thought process, if you have made him curious enough to look more deeply into a subject, if you have changed his point of view, then your exhibition has been successful, and your visitor is "off the ground."

Museum Extension through Traveling Museums

ARNOLD B. GROBMAN, DIRECTOR
FLORIDA STATE MUSEUM

A well-organized museum has three major functions. The first is to serve as a repository for the material objects of our cultural and natural heritage. The second is to conduct investigations on these and related objects. And the third is to disseminate knowledge, especially that gained through the museum's own studies.

The last-named activity is an educational function, and in practice two kinds of audiences are served in different ways. For the specialized scholar, the museum prepares technical publications announcing new findings. For the ordinary citizen, the museum's major service is to instruct through displays and exhibits of broad general interest.

Now, in a municipal museum—one of which the clientele consists primarily of the residents of a single urban area—these displays may be housed in a centrally located building and thereby provide adequate museum service for the museum's community. This is not, of course, true for a national, state, or provincial museum. Such a regional museum has a very real responsibility to people living throughout the whole area and not just to those in the capital city.

How are the people to benefit from museum display services when they live some distance away from the museum exhibit building in the capital city? There are several ways partially to overcome this remoteness. One method is to construct additional display buildings throughout the region. However, such a project is very expensive, and to reach most of the people in rural areas it becomes quite impractical. Another way is to transport people from outlying areas to the central museum building periodically, which is satisfactory for certain kinds of organized groups,

such as school classes, but does not operate effectively for the bulk of society. Still another device is for the museum to send displays to communities by mail or express. This method, which has been more frequently utilized with art than with natural history objects, has a drawback in that there may often be no one at the receiving end who can arrange and handle the displays properly. Also, considerable time is wasted in the packing and unpacking of displays. All three methods of extending museum display services to dispersed residents of a large region are used effectively in Europe and America. While valuable techniques, they have various disadvantages, some of which are indicated above.

A fourth method is to house displays in a vehicle that can travel throughout the region, visiting isolated villages, as well as metropolitan centers, so that virtually all the regional residents have an opportunity to enjoy museum exhibits. These traveling museums are a very effective method for providing extension services for a national, provincial, or state museum.

Our own Mobile Exhibits (presently inoperative) are contained in two converted buses, with fourteen displays on panels that can be removed and replaced by two men in less than a full working day. The exhibits are planned for all age groups, and we find that the average visitor takes about thirty minutes to see all the displays. School classes can go through at the rate of 150 children per hour, without serious crowding. Daily attendance, depending on population density and visiting hours, can reach 2000.

We have participated in fairs and expositions. However, our normal schedule was to visit schools during school days and town squares on weekends. For every 800 students at a given school, we remained on the grounds one day.

Our drivers required about a half-hour to set up after arriving on the scene and about a half-hour to break down preparatory to changing locations. Our drivers were trained teachers with master's degrees in education. They were able to work well with principals, teachers, and pupils.

We visited only those localities that had a paved road and a source of 110-volt current not more than 100 feet from where the Mobile Exhibits were to be parked. (Of course, a gas-powered generator could be used to extend the maneuverability of the vehicles if that were necessary.)

Our Florida expenses conformed closely to the following schedule: fifty cents per mile of travel plus fifteen dollars per day of operation. In addition, the two drivers received a ten-month salary of $3200 each. Brochures, which were distributed free, cost about one cent each to produce. During our most extensive tour, the total costs averaged about eight cents per visitor. Thus the normal visitor to the Mobile Exhibits

studies the displays for about a half-hour at a cost to us of eight cents each. It is estimated that the average visitor to our museum building spends about two hours there at a cost to us of about seventy cents each.

The following picture story shows the work that is being done by our museum in Gainesville, Florida; the Historymobile of the Wisconsin Historical Society; the American Museum of Atomic Energy at Oak Ridge, Tennessee; and the Artmobile of the Virginia Museum of Fine Arts.

Other American units, not shown here, include the Mobile Unit of the Nevada State Museum; the New York Artmobile; the Traveling Trailside Museum of the Cleveland Museum of Natural History; and the Trailercoach of the Children's Museum of Washington, D.C.

The traveling museum has, of course, much wider application than in the traditional museum field alone. It can be used to bring to great masses of people new techniques leading to higher standards of living in an expanding economy as well as providing intellectual stimulation.

Traveling museums seem to possess these advantages: 1. They bring museum displays to many persons who might not otherwise have an

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	MOBILE EXHIBITS, FLORIDA	MUSEUMOBILE, ILLINOIS[1]	MOBILE UNIT, NEVADA[2]	HISTORY-MOBILE, WISCONSIN[3]
Kind of Unit	2 buses	1 van	Pick-up truck, house trailer	Pick-up truck, house trailer
Initial outlay, vehicles only	\$15,000[4]	\$20,000	\$5,500	\$9,000[5]
Number of drivers	2	1	1	2[6]
Linear feet of exhibits	120	60	55	88
Miles per month	360	600	800	827
Proportion of state covered annually	0.50	0.33	1.00	1.00
Number of visitors per month	16,550	10,000	8,750[7]	21,700
Actual monthly operating costs reported, not including cost of displays	\$1,328	\$800	\$950	\$1,248
Monthly operating costs based on: driver at \$4,000 annually; 300 days annually at \$9.00 daily; 25¢ per mile, van or bus; 15¢ per mile, pick-up truck; 500 miles monthly	\$1,367	\$683	\$633	\$1,242
Estimated cost per visitor	\$0.083	\$0.068	\$0.072	\$0.057

[1] Data courtesy of Dr. Thorne Deuel, Illinois State Museum. [2] Data courtesy of Mr. J. W. Calhoun, Nevada State Museum. [3] Pictures and data courtesy of Mr. Clifford L. Lord, State Historical Society of Wisconsin. [4] Purchased second hand; estimated replacement cost, \$60,000. [5] Mostly donated by industrial firms; replacement value of unequipped vehicles, \$4,845. [6] Man and wife who live in trailer. [7] 53,981 school children in 8 months; approximate number of adults in addition, 16,000.

Fig. 1

Fig. 2

Fig. 3

Fig. 1. Mobile Exhibits of the Florida State Museum. Note how the converted buses are parked so that side doorways are connected by a canopy-covered ramp. The seats have been removed from the buses, the windows covered over, and exhibit cases installed.

Fig. 2. A corner of the interior of one of the Mobile Exhibits. This exhibit case tells part of the story of the history of Florida. The selection of objects is economical, and the attached labels are large and easy to read.

Fig. 3. Another part of the interior shows the relatively roomy space before the exhibits. Each bus has seven self-illuminated display cases about four feet square, with an average depth of about twelve inches. A public address system can be used for music or a message.

Fig. 4

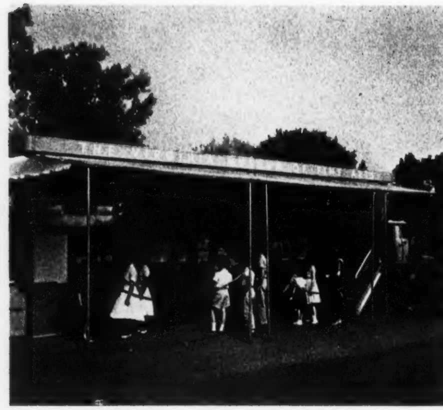

Fig. 5

Fig. 6

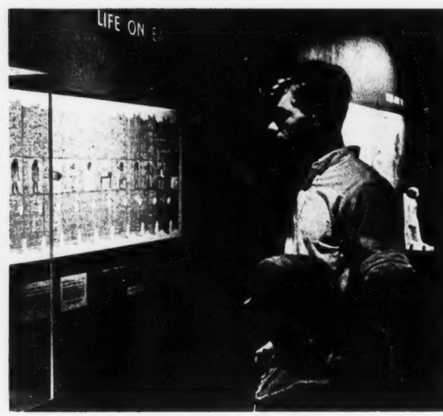

Fig. 7

Fig. 4. The Artmobile of the Virginia Museum of Fine Arts is a truck and trailer with fold-out sides, which greatly increase the display area but require considerable time to set up and take down.

Fig. 5. The Virginia Museum of Fine Arts Artmobile utilizes available space both inside and outside the trailer. A canopy protects the exterior exhibits from the weather and gives the trailer the appearance of a compact building.

Fig. 6. Exhibits in the Virginia Artmobile are well planned, dramatic, and well lighted. Various exhibition techniques are apparent in this photograph, including the "peep-show" opening that gives much for little space.

Fig. 7. Small groups of visitors take about thirty minutes to cover a traveling exhibit. A class visiting this Virginia Artmobile exhibit would go through at about 150 pupils per hour.

Fig. 8

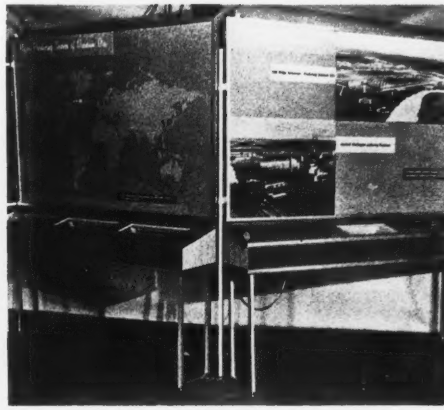

Fig. 9

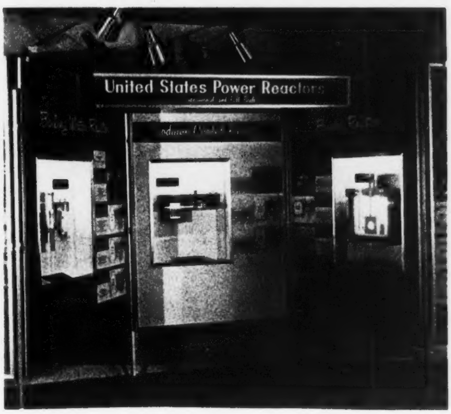

Fig. 10

Fig. 11

Fig. 8. The American Museum of Atomic Lnergy, Oak Ridge, Tennessee, has a fleet of traveling museums. The type shown here is a walk-into truck similar to that used by the Illinois State Museum for its Museumobile.

Fig. 9. Interesting slanting cases, combined with panels, are used in the Atomic Energy Museum's traveling museum to show the major producing sources of uranium ore and the products of uranium.

Fig. 10. Staggered panels increase exhibition area in this exhibit of United States power reactors in the traveling museum of the American Museum of Atomic Energy.

Fig. 11. A corner of the Atoms for Peace exhibit in the traveling museum shows the relatively spacious effect attained. The Museum also used large trucks and trailer housings and one-ton panel trucks for school exhibitions.

opportunity for such an experience. 2. They cost less to operate, per visitor, than a central museum building. 3. They stimulate the citizen's interest in museums. 4. They are an especially valuable educational and enrichment source for rural residents living remote from metropolitan areas. 5. They are adaptable to the major museum fields of art, science, and history. 6. They provide regional museums with an opportunity to provide regional coverage in the display program.

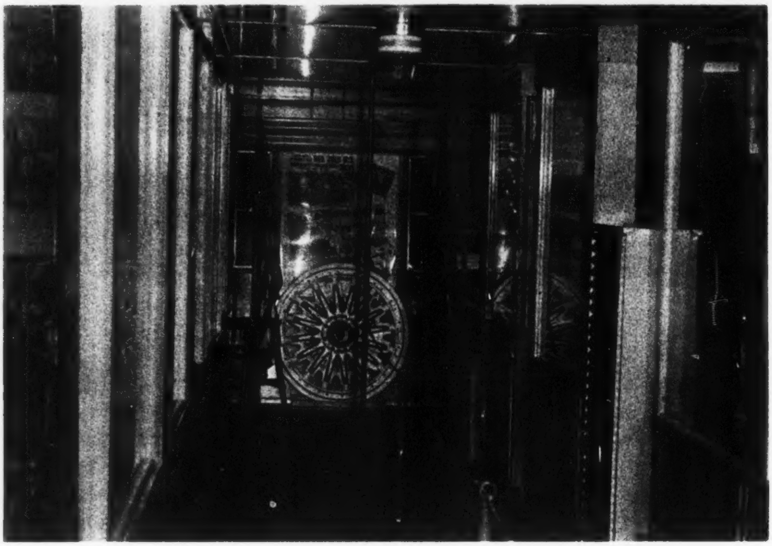

Fig. 12. The Historymobile of the Wisconsin Historical Society consists of a converted house trailer pulled by a pick-up truck. The added length of a house trailer permits a maximum of exhibition space to be used.

Fig. 13. Interior of the Historymobile of the Wisconsin Historical Society. The driver of this traveling museum and his wife sleep aboard, reducing display space but saving on per diem costs. Note the old Sells-Floto circus poster.

Security and Protection in a Museum

MICHAEL J. PAKALIK, PROTECTION SUPERVISOR
THE AMERICAN MUSEUM OF NATURAL HISTORY

A museum has five areas of protection—its own physical plant, its collections, its visitors, its own employees, and its reputation. With an institution the size of The American Museum of Natural History this becomes a large order. More than two million visitors come into the building each year, and more than six hundred employees sign the time sheet.

The American Museum is situated in a ten-block area from 77th Street to 81st Street and from Central Park West to Columbus Avenue. Within this area are seventeen buildings housing the administrative and scientific staffs, public instruction, research laboratories, the mechanical shops, storerooms, libraries, offices, the accounting department, purchasing, exhibition and design, and a multitude of other departments devoted to the operation and upkeep of the Museum. The total Museum area is 23.27 acres, and of this, 11.5 acres are open to the public.

The Museum is located in a neighborhood that has gradually become depressed over the years and is considered by the New York Police Department to be a "high hazard" area. This means that the possibility of vandalism is greater than if the institution were located in an upper-income residential section of the city. For the good of the Museum and its visitors, the administration took steps to cope with the situation by creating a security police force, or the Protection Division as it is called.

The responsibility for the operation of the Protection Division was given to me late in 1952. In setting up the Division, I carefully screened and checked my personnel, looking into their backgrounds and weighing their potentialities and abilities. The men I selected were sworn in as peace officers by the New York City Police Department and were trained in proper police and law enforcement procedures.

Two units make up the Protection Division—a uniformed police force

and a detective force. The uniformed police patrol the outside area of the Museum and the Planetarium. Each officer assigned to his post reports by telephone hourly to the division office. Each man is familiar with traffic control and has a basic knowledge of first aid in the event of emergencies.

The plainclothes detective force operates within the Museum, patrolling the exhibition halls. These men receive additional training in investigation, interrogation procedures, presentation of evidence, and in the securing of witnesses.

When we first began the protection operation, some interesting sidelights of detective work came up. I found it necessary to train a new man to behave like a museum visitor so that he did not look like a bloodhound following a scent. Museum visitors stop before exhibits, read labels, wander from one thing to another, and frequently sit down to rest their weary feet. I found that a little training made it possible for my new men to act like visitors and thus attract little or no attention to what they were actually investigating.

On various occasions people with larceny in their souls slip past the elevator operators and get to the top floor of the Museum where the laboratories and offices are mainly located and which is not open to the public. We have had secretaries' handbags stolen, cameras lifted, and even incidents of molestation. To aid our detective force we installed a special red telephone with a very loud gong in the protection office. When an employee is in trouble or sees improper acts, either in the exhibition halls or in sections not customarily open to the public, he dials 222, and my men are on the spot in seconds or minutes.

This coded telephone is used not only for emergencies but also for prevention of incidents. I have tried to impress on every employee, from the director down, that we would rather answer a hundred false alarms than miss one real chance to nip a crime in the bud. I am gratified to say that Museum people do not now hesitate to call 222 in case of trouble.

To give you an idea of the operation of the Protection Division, a sample of the report made monthly to the administration includes reported thefts, morals offenders, assaults on visitors, disorderly visitors, vandalism, flood, fire, first-aid cases, fingerprints taken of new employees, photographs for identification cards, and the number of 222 calls answered within the reported month.

In addition to protecting the visitors who come to the Museum, it is also necessary to protect the institution when new personnel are employed. Because many of the employees deal with children, we must fingerprint each new man or woman who is hired for a job and send the prints to the New York Police Department for checking. More than once we have turned up a police record, but we usually note the number

of years elapsed, with no desire to punish further a person who once made a mistake but has since been on good behavior.

On rare occasions a Museum employee will be tempted to steal materials or to engage in petty office theft. Fortunately, we have not had much of such pilfering, and we usually apprehend the culprit in short order. Immediate dismissal but without court action is the usual procedure.

To protect the Museum after hours, the Watch Force was reorganized. A continuous patrol was set in motion so that coverage is maintained at all times. Classes were held in fire control, and instructions given on the various types of fires and the proper equipment and methods to use in combating blazes of every type. Fire stations are assigned to men on duty, and the rest of the force are given protective posts. When both the day and night forces were in good operation, I felt that the Museum had adequate protection, and the results began to show up in a steadily decreasing array of incidents.

With our clean-up operation, particularly of teen-age toughs and vandals, we have collected a "chamber of horrors"—an exhibition of destructive weapons and implements that includes knives, billies, slingshots, zip guns, water pistols, glass cutters, and other objects that have been turned over to the Police Department.

Experience has made us wise in learning new crime techniques. We found that a unique method of purse-snatching was employed in the area of the Museum. A group of boys approached a woman visitor near the building, and one squirted a water pistol into her face. An accomplice then attempted to snatch her purse as she raised her hands to ward off the attack, intending to hop over the wall into adjacent Central Park and disappear into the shrubbery. In the initial attempt, we prevented such an outrage because of the alertness of the Museum's uniformed patrolman.

We find, from our contacts with the teen-age groups, that their arrogance and bravado disappear on individual questioning and cross examination. In a group they are bold. Alone, they are frightened and show that they are youngsters, momentarily bewildered or maladjusted towards society. Separated parents, unhappy home lives, and lack of parental guidance are the important factors behind the behavior of most of these boys.

With morals offenders, our problems are different in nature. We are here dealing with male adults, some married and with families, who are mentally disturbed. The reluctance of the victim, in most morals cases, makes it difficult to do more than warn the offender off the premises and forbid his return. The victim's embarrassment or the fear of publicity and lost time in court militate against the pressing of charges.

When the victim fails to press charges in a morals case, we can only impress on the offender the seriousness of his act. We try to show him the effect that public knowledge of what he has done would have on his family, and his business and social contacts. In many cases, the offender cooperates and permits us to make arrangements with social workers or a medical institution near his home for admittance for psychiatric care. Our records show that a small advance has been made along these lines, judging from personal visits and telephone calls from former offenders who have undergone rehabilitation. Their gratitude is rewarding.

New York's Police Commissioner, Stephen P. Kennedy, aware of the part played by protection and security, inaugurated a security method and operation course at the New York Police Academy, under the direction of Inspector R. J. Gallati. Members of the Police Department are allowed to attend, and outside organizations, such as our own American Museum, the New York State Police, the New York Waterfront Commission, and others sent representatives. The result of the cooperation between the Police Department and the security agencies created an understanding spirit of mutual concern.

As any other institution, the Museum suffers losses through burglary, pilferage, and petty thefts. Protection copes with such losses by making thorough investigations and, upon the apprehension of the suspects, appears in court as complainants for the Museum.

One overriding concern in security and protection work in any public institution is the public relations factor. The reputation of the Museum is at stake as well as the safety of Museum visitors and employees. We must proceed surely and with definite proof and facts before we take any definitive action. No institution can afford to offend the public or to press action repugnant to a potential complainant.

In addition to this, there is a Museum obligation to the Police Department, the public health, and the press. When a quiver of poisonous curare-tipped darts was stolen from the Museum, we did not want to alarm the public by broadcasting the theft. But the potentialities of public panic and harm were greater than our desire to protect the institution from undesirable publicity, so we notified the police, the public health authorities, the hospitals, and the press at once. Two days later—two long days that seemed like two years to us at the Museum—a father was reading his paper, saw a picture of curare-tipped darts in a story about the theft, glanced down at his twelve-year-old son who was apparently playing at jackstraws with a handful of thin, black-tipped sticks, and the mystery was solved, the darts were recovered, and nobody got hurt.

Summing up, security and protection in a cultural institution present

five factors which have to be recognized:

1. We must protect our visitors from potential danger, harm, or annoyance by using every means at our command.

2. We must protect the physical plant of the Museum by maintaining a high level of professional protection personnel.

3. We must safeguard our own employees by rapid and efficient responses to emergency or warning calls and by investigation of new employees.

4. We must guarantee the safety of our collections by using the most modern methods available in the fields of electronic and mechanical devices.

5. We must safeguard the reputation of the Museum by carrying out our work with foresight and intelligence, seeing clearly in advance the ultimate results of our acts so that the best interests of the Museum, its employees, and the public are served.

Only by full recognition of these five factors can we do our best work for the institution of which we are an integral part.

CURATOR BOOK REVIEWS

The Travels of William Bartram. *Naturalist's Edition, edited by Francis Harper. New Haven, Yale University Press, 1958, 727 pp., illustrated, $8.50*

In the eighteenth century, William Bartram, the famous natural scientist, who was a member of the Society of Friends, made a journey through the Southern colonies, and the record of his peregrinations is a classic of American natural history. The original "Travels," published in 1791, has been added to and embellished by Mr. Harper, research associate of the John Bartram Association in Philadelphia, and his skillful editing has made the work of even greater use to the botanist, the zoologist, the historian, the geographer, or the ethnologist who requires current nomenclature and accurate information on life in the colonial southeast.

The book now contains a preface; an introduction, containing an account of Bartram's life; a commentary on geographical, historical, and various other matters; an annotated index, providing, among other things, identifications of Bartram's plants and animals, biographical notes on persons, definitions of unusual or familiar terms, information on Indian tribes, and the location of geographical features; a bibliography of publications, manuscripts, maps, and atlases; and maps and figures inserted at the end of the volume.

Bartram's father, John Bartram, founded the famous Botanical Gardens on the west bank of the Schuylkill River near Philadelphia. After the senior Bartram's appointment as botanist to His Majesty King George III in 1765, he took his son William, who was twenty-six years

old, to Florida on an expedition. This pioneering experience as his father's companion and assistant doubtless furnished much of the basic training and qualification for the younger Bartram's solitary travels and studies of nature in the southeast in the next ten years.

Bartram's observations during nearly four years of travel remind one of the early journalists (using the word in its exact sense). As did Boswell or Pepys or Thoreau, he wrote of everything and everybody he saw and he wrote with a continuing sense of painstaking and accurate wonder! He spoke with friendly solicitude of the Indian tribes with whom he came in contact and suggested that the United States Government send men "of ability and virtue . . . as friendly visitors, into their towns; let these men be instructed to learn perfectly their languages, and by a liberal and friendly intimacy, become acquainted with their customs and usages, . . . their system of legislation and police, as well as their most ancient and present traditions and history." He went on to say that such men should return to the legislature of the United States to make intelligent recommendations for ". . . a judicious plan for their civilization and union with us."

His "Travels" did not receive good notices when they first appeared, and that his counsel was not heeded is evident in the fact that the Seminoles were still technically at war with the United States Government a few years ago. It is entirely possible that, had Bartram's good Quaker advice been followed, we would not have suffered the losses and the dishonors of the Seminole and Creek Wars, or the tragedy of the Cherokee Removal, and Andrew Jackson might never have become President of the United States. Sometimes a bad review, even in the eighteenth century, may potentially affect the course of history!

The worth of Bartram was not fully recognized in the United States, and no new edition of the "Travels" appeared until 136 years after the original publication. Europe was more discerning, and eight or nine editions were called for within the first ten years. America was too busy expanding in all directions to take the trouble to look really closely at her own great men of genius.

This most recent publication of Bartram's "Travels"—this wonderfully detailed interpretation of his contributions as a naturalist—has long been overdue, but its emergence from literary obscurity places it on the bookshelf next to the works of Thoreau, Burroughs, Muir, Buffon, Krutch, Teale, and the many others who have written of nature not alone in company with a slide rule and microscope but also with a pen burnished in the fire of their enthusiasm.

His work, although hitherto criticized for its florid style, served as a source for some of the finest imagery of Wordsworth and Coleridge, both of whom praised his writings. William Bartram's "Travels" will be of considerable use to the natural scientist, as a guide to what was then virgin country. To those who enjoy interesting people, their actions and reactions to the world around them, this book will provide an instructive and entertaining fortnight of good reading.

W. A. B.

Interpreting Our Heritage. *Freeman Tilden, Chapel Hill, The University of North Carolina Press, 1957, 110 pp., 41 illustrations, $3.50*

This small but extremely provocative book is an attempt to set forth the basic principles upon which good interpretation may be built. Primarily, it is a book for those responsible for planning and conducting programs of interpretation in national and state parks, in museums, and at historic places. It should be a book of considerable interest to all engaged in any form of public instruction.

Mr. Tilden, already established as a successful novelist and short-story writer, has in recent years become concerned with conservation and has become a collaborator in the National Park Service, upon the invitation of its director. He has prepared this study under the guidance of Ronald F. Lee, Chief of the Division of Interpretation of the same service.

The author's skill as a writer is evident in the excellent organization of the book which basically consists of formulating a new definition of interpretation and then supporting that definition with six basic principles. The bulk of the book is a clever and inspiring explanation of each of the six basic principles in operation. It is not a "how-to-do-it" or a "how-we-did-it" kind of book, although the practical examples of good interpretation are extremely well chosen and discussed. Rather is this book itself a beautifully worked-out interpretation of interpretation. Freeman Tilden points out that at the moment there seems to be more leisure time ". . . than the majority of people seem to be able to convert to the enrichment of mind and spirit." He sees the greatest hope for helping people make a happy and fruitful use of leisure to be in parks, museums, and other cultural preserves. The author makes no claim to the discovery of the ideal way of stimulating worthwhile leisure activity, but he is certain that ". . . it cannot be done merely by displaying wares, nor by imparting mere facts."

Every museum educator would do well, however, to find out what Mr. Tilden has to say about stimulating the visitor ". . . toward a desire to widen his horizon of interests and knowledge, and to gain an understanding of the greater truths that lie behind any statement of fact."

The text stands on its own merits. The excellent illustrations are but an extra dividend for the reader.

J. R. S.

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